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Identification and analysis of agricultural supply control alternatives

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IDENTIFICATION AND ANALYSIS OF AGRICULTURAL
SUPPLY CONTROL ALTERNATIVES

by

Alvin Edward House

A Dissertation Submitted to the
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DOCTOR OF PHILOSOPHY

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INTRODUCTION

This dissertation has for its foundation four hypotheses:

(1) The limitation of technological discovery and development is not a feasible means of limiting agricultural supply in the United States. Such limitation would inhibit progress toward personal and societal goals of paramount importance.

(2) Following from the first hypothesis, if limitation of technological discovery and development is not feasible, then supply regulating institutions must limit agricultural production to desired aggregate levels in the presence of large excess productive capacity.

(3) Technologies are differential factors in respect to their impact upon farm firms. It would therefore seem appropriate for experiment stations to carry out long range research projects with the objective of developing technologies specifically adaptable to each of the several stages of economic development, and technologies specifically adaptable to each of two recurring types of demand for agricultural products within the United States.

(4) In the United States neither constitutional law nor common law necessarily inhibit the development and implementation of effective institutional changes. On the contrary, existing concepts of law provide a basic framework sufficient for implementing effective agricultural programs. Economists can assist in creating more effective regulatory programs if they comprehend the nature and function of the regulatory

framework.

Nature of the Problem

The four hypotheses evolved from a study of technological development in Europe and the United States and from a study of structural deficiencies arising under the impact of rapid technological evolution. The nature of the problem can be set forth in five propositions:

(1) An increasing flow of basic technology will be forthcoming as long as there are intensely curious people within modern society. As these people develop a measure of political acumen along with technical competency, they assure for themselves reasonably adequate financial resources for carrying on inquiry.

(2) There is a high probability of an increasing rate of technological development in the United States. Personal, group and societal goals call for increasing technological development.

(3) There is a high probability of continuing adaptation of new technology to agricultural production and to means of food and fiber production which compete with agriculture for consumers' expenditures.

(4) Policy makers responsible for drafting agricultural legislation have failed to take sufficient cognizance of the nature of the varied impacts of technologies and the many routes by which technologies reach the agricultural production

function.

(5) The institutional structure which has evolved over past decades is inadequate for accommodating agricultural change without transgressing widely accepted welfare principles or inhibiting economic development.

Purposes of the Study

In the attempt to set forth the problem and to evaluate partial solutions which have been suggested, five purposes emerge:

(1) To examine the origin and development of certain technologies affecting agricultural development.

(2) To analyze the differential nature of technologies as factors affecting agricultural development.

(3) To appraise certain existing and proposed agricultural programs in light of technological developments and demand requirements.

(4) To suggest reorientation of agricultural programs to accommodate technological development.

(5) To examine the adequacy of the framework of existing legal concepts for implementing suggested agricultural programs.

Methodology of the Study and Plan of the Report

The method of analysis used involves case studies. In the second chapter specific cases of technological discovery,

development and adaptation form the basis of the analysis. The personal and group goals supporting technological evolution will be identified and discussed in each case.

In the third chapter the same cases discussed in the first chapter form the basis of a brief examination of the differential character of technologies affecting agriculture.

In the fourth chapter agricultural programs and features of programs which have been used in the past form the basis of an evaluation of the impact of programs upon effective shifts in resource use in response to the widely fluctuating demand conditions caused by alternating war and nominal peace.

In the fifth chapter suggested remedial supply control programs become the basis for the case study. The economic impacts of the various features will be evaluated.

In the sixth chapter court cases become the basis for evaluation of existing law as an effective framework supporting and implementing economic development.

Finally, the seventh chapter presents a summary of the study and suggests certain conclusions in the nature of recommendations for further studies.

IDENTIFICATION AND EVALUATION OF PERSONAL AND SOCIETAL
GOALS SUPPORTING BASIC DISCOVERY, DEVELOPMENT AND
ADAPTATION OF NEW FOOD PRODUCTION TECHNOLOGIES

Framework of Analysis

The following terminology will be used in case studies of technological evolution:

- (1) Basic research will refer to fundamental inquiry into the nature of the physical, biological and human relationships within the environment. The term discovery is convenient and familiar, so it will occasionally be used to refer to findings arising out of basic research.
- (2) Technological development will refer to the development of production technologies or ideas with the objective of eventual adaptation to production or consumption.
- (3) Technological adaptation will refer to the actual adaptation of a developed technology to production or consumption.

The two-fold purpose of this chapter is (1) to identify and evaluate the importance of personal and group goals in supporting the flow of new technologies, and (2) to take cognizance of the routes by which new technologies have reached the agricultural production function.

As the case studies proceed the goals and motivating

forces generating technological evolution will be identified and discussed. In the last three sections of the chapter societal goals will be discussed in a more general setting.

The personal goals, or motivating forces, which will be evaluated are: (1) curiosity, (2) professional status and satisfaction from reporting and discussing research findings with colleagues, (3) altruism, and (4) economic rewards.

The group or societal goals which will be evaluated are: (1) war potential, or defense potential, (2) domestic economic development, (3) contingency reserves of technologies, productive resources and/or food supplies, and (4) education.

The micro economist working with an individual firm may view the supply of developed technologies as though they were lined up on a cafeteria counter. But the economist interested in the great shifts in resource use and the consequences of these shifts to personal and group welfare must look beyond the supplies of agricultural technologies all the way to the mind of the scientist.

The thesis of this dissertation rests upon the assumption that certain stages of technological evolution are inevitably forthcoming in most western societies as long as intellectual curiosity stirs a few individuals to inquire into the natural order. Other stages are more sensitive to the sense of urgency driving groups to mobilize resources in pursuit of some goal. Still other stages are sensitive to the competitive tempo of the industrial order. The case studies which follow provide a

framework for examining the forces behind the evolution of technologies of importance to agriculture.

The Discovery, Development and Adaptation of Fertilizer Technologies

A significant proportion of the people of the world today derive their subsistence from fertilizer technology. After the original humus of soils under intensive cultivation had disappeared, soils became relatively unproductive in Western Europe, and later in the United States. Organic fertilizers were not available in sufficient quantities for increasing productivities enough to support growing populations. It is not clear whether or not this situation stimulated scientists in their research leading to inorganic fertilizer technologies, but fears arising out of diminishing soil productivity did provide a stimulus to the development of fertilizer technologies, once the basic scientific foundation had been established.

Historically, the development of fertilizer technologies has been inseparable from development of war potential in a number of countries. In addition, many of the same chemical components which are a part of fertilizer technologies are important industrial compounds used in a wide variety of manufacturing processes.

In his book, The World Fertilizer Economy, Mirko Lamer pointed out that the science of inorganic chemical fertilizers did not develop until the beginning of the 19th century (58,

p. 36). The man contributing the most to the early development of the science was Nicholas Theodore de Saussure, a Swiss scientist. By means of both qualitative and quantitative chemical analysis he proved that plants derive their nitrogen and mineral matter from the soil and their oxygen from the atmosphere. Although his work provided the foundation for fertilizer technology, De Saussure did not live to see his theories put to practical use. In this sense he was typical of early scientists. Scientists of the period were unique among professional men working with material substances. Craftsmen and artists could frequently admire the finished product as it adorned a fine home or perhaps a great church. But the scientist, after a lifetime of work, frequently had produced nothing of use or interest to his contemporaries.

It would seem that these early scientists were motivated primarily by curiosity. The few scientists of the period in which Leonardo da Vinci lived were motivated primarily by curiosity, for there is little evidence of the presence of other motivating factors. Scientists of da Vinci's time received a sort of negative return from society for their efforts. They were considered as dangerous to entrenched philosophies and theologies. But by the beginning of the 18th century scientists were generally respected, and in Paris and London science was becoming fashionable.

As scientists became respectable they were more easily ignored by society, especially during early periods during

which scientific inquiry yielded no practical results of significance. As scientific inquiry and pedagogy were institutionalized by universities, scientists gained respect, a measure of security, and facilities with which to carry on their work. Since evaluation of the importance of basic research frequently was not possible until after the death of scientists, very little is known about many of the early scientists themselves. But the circumstances surrounding their work point to curiosity as a primary motivating force.

De Saussure contributed only a method of analysis to fertilizer technology. He apparently did not envision commercial fertilizer technology. Baron Justus von Liebig was the first to recommend soil fertilization in 1840 (58, p. 37). But G. B. Lawes, without knowledge of the work of De Saussure or Liebig, first produced fertilizers in quantity by treating both bones and mineral calcium phosphate with sulfuric acid in 1843 in his barn in Rothamsted. Both Liebig and Lawes discovered that the treatment of calcium phosphate with sulfuric acid rendered the phosphate ion readily available to plants. The resulting product was called superphosphate, and this substance became the world's first chemical fertilizer.

When a scientist such as Lawes not only makes a fundamental discovery, but develops the technology to the point of adaptation to production, the motivating factors sometimes become cloudy. In Lawes' case, however, there is a strong indication of service to society involved as a motivating

factor, for he and his colleague, Gilbert, established at Rothamsted one of the most important experimental stations in the world for research in the fertilizer field.

Production of superphosphate increased the total demand for sulfuric acid relatively little until the 20th century, in part because farmers were slow in adapting inorganic fertilizers, and in part because of the relatively greater quantities used in nonagricultural industries. For 200 years sulfuric acid has been the most important industrial chemical. The acid has played a vital role in domestic enterprise, and in the waging of war through the manufacture of explosives (37, p. 38).

In the early 1900's it was discovered that platinum, used as a catalyst, speeded up the natural reaction of sulfur dioxide and oxygen to form sulfur trioxide. Sulfur trioxide easily reacts with water to form sulfuric acid. The process produces a much higher grade acid than the old lead chamber process. But even with the more efficient method of production sulphuric acid was conserved during World War II as a strategic war material by developing other processes for treating calcium phosphate. Phosphoric acid is now widely used both because of the effort to conserve sulfuric acid, and because phosphoric acid yields a product of higher concentration of available phosphate. Nitric acid is also used to treat calcium phosphate and yields ammonium phosphate, containing both nitrogen and available phosphate.

Nitric acid is another chemical of great importance to agriculture, and to the high explosive industry as well. It was mentioned above that calcium phosphate may be treated with nitric acid to form ammonium phosphate. Nitric acid may also be used to produce ammonium nitrate, synthetic sodium nitrate or virtually any commercially used nitrate form. During the 19th century nitrate fertilizers were supplied from natural sources of guano, found chiefly in South America. Lamer pointed out that the prospect of exhaustion of known natural nitrate sources was a factor in the pessimistic outlook of Sir William Crookes in 1898 when he began to make pronouncements with Malthusian overtones (58, p. 38).

Francis pointed out that scientists in Europe had considered the possibility of synthesizing nitrates from atmospheric nitrogen for a number of years before the end of the 19th century (37, p. 60). German and Norwegian scientists developed methods of synthesis requiring large quantities of cheap electric power, but a German chemist by the name of Fritz Haber succeeded in 1904 in synthesizing ammonia using atmospheric nitrogen and hydrogen from coke furnaces. Over a decade before he discovered that uranium will act as a catalyst (other catalysts were subsequently developed) for producing ammonia from nitrogen and hydrogen. About the same time another German chemist, Wilhelm Ostwald, discovered that platinum will function as a catalyst for speeding up a second reaction whereby nitric acid can be made from ammonia. Francis

stated that by 1915 Germany had developed this industry to such an extent that she was able to manufacture nitrates in sufficient quantities to make her independent of nitrates in natural forms. The industry represented a vital source of military power during World War I (37, p. 61).

Again in World War II Germany's synthetic ammonia industry played a vital role, but this time the United States, Canada and Britain became important producers of synthetic ammonia and nitrates. In 1940 the United States had a synthetic nitrogen producing capacity of about 380,300 tons. During World War II, ten synthetic nitrogen plants were established by the government of the United States at a cost of \$238 million. By 1945 the United States had 19 synthetic nitrogen plants with a capacity of 1,285,000 tons per year. By 1951 capacity had increased to 1,616,000 tons of nitrogen. Nitrogen produced as a by-product in steel manufacturing increased relatively little from 1940 to 1951, at which time the capacity was only 205,000 tons (58, p. 215).

Lamer pointed out that the increased wartime production facilities were not created primarily for the purpose of serving agriculture. Agriculture's consumption of nitrogen increased absolutely, but agriculture's share of all nitrogen production dropped from 50 per cent in 1939 to 43 per cent in 1944-45. Most of the government-owned plants served the military directly. By 1951 the United States government had disposed of all but one synthetic ammonia plant. Immediately

after the war five of the ten government plants for producing synthetic ammonia were sold for a total of \$47 million. The original cost of the five plants was \$131 million (58, p. 215). During the peak year of war activity about 75% of all anhydrous ammonia available went into military use, while in 1950 about 70% was used in agriculture (58, p. 219).

One can only speculate about the personal motives of Fritz Haber and Wilhelm Ostwald as they labored in their laboratories to develop a catalyst which would hasten a well-known natural chemical reaction, and as they searched for a set of environmental conditions in which the reaction would take place efficiently. By this time they were building upon the findings of scientists who had gone before them. In 1900 these gentlemen could not have been working in anticipation of World War I, but there was active interest in nitrogen bearing fertilizers, and fertilizer experiments had been carried on in England for over half a century. Agricultural uses were probably strongly in the minds of the scientists. Traditional scientific curiosity was probably a strong motive. By 1913 the military uses of nitric acid created compelling motives supporting rapid development of the technology.

The objectives of the German society in respect to the rapid development of the synthetic process may be more readily understood. The primary societal motive in 1904, at the outset of the period of rapid development of the process, could have been primarily agriculturally oriented. As stated above,

there was fear among Europeans that agriculture would soon run through the remaining natural supplies of inorganic nitrate-bearing fertilizers. But within the next 10 years the primary motive probably changed from one of domestic orientation to one of war orientation. However, Lamer stated that nations needed relatively less nitrogen during World War I than in World War II because of the relatively small amount of heavy artillery and bombs used in World War I. During World War II, Germany again boosted synthetic nitrogen output and explosives industries used the larger part of the output (58, p. 199). During World War II the United States more than tripled its nitrogen producing capacity, then sold or leased practically new manufacturing facilities to private industry at prices returning less than one-third original cost. After the war owners of these plants began selling nitrogen to farmers, who fertilized crops to be sold at government supported prices.

The acquisition and disposal of the nitrogen manufacturing plants illustrates the urgency of two societal goals. (1) When a group becomes convinced that a certain war potential norm must be achieved and maintained as a condition upon which its way of life rests, then the necessary mobilization of effort and resources will be accomplished. (2) But people have come to expect that most of the research and a significant part of the development investments in war and defense will yield valuable returns to the domestic economy, and do it quickly. People become impatient if social overhead capital

expenditures do not contribute to the industrial order based on domestic enterprise and consumption. The development of nitrogen technologies and manufacturing facilities by the United States government resulted in such reduced costs of producing nitrogen fertilizers that the synthesized nitrates have largely replaced nitrates from natural sources (58, p. 138), and nitrogen fertilizer has replaced more land than would have been replaced at higher nitrogen costs.

The motivating forces supporting the adaptation of fertilizers to agricultural production have arisen primarily out of economic considerations. These production problems have been analyzed elsewhere. The problem has been primarily one of substitution of expenditures on fertilizers for expenditures upon additional land in achieving some increase in output. Various restrictions at the level of the firm have reduced the supply of land in farming communities, thus increasing the tendency to increase output by means of fertilization rather than by means of additional land. These problems are discussed in a later chapter.

Discovery, Development and Adaptation of Herbicides and Insecticides

The route by which the material now popularly known as DDT reached the agricultural production function illustrates the function of several of the motives and goals previously mentioned. Frear credits Zeidler, a German chemist, with the

discovery of DDT (40, p. 57) in 1874. Frear described the discovery as follows:

The material now popularly known as DDT was first synthesized and described by Zeidler in 1874. To him it was simply another new organic chemical, the preparation and properties of which were worth reporting for future generations of organic chemists, nothing more. As far as is known, he made no effort to find practical applications for the compound; indeed, it would have been surprising if he had done so, for the organic chemists of that period were mainly explorers in the relatively unknown field of organic synthesis, and in general were not particularly interested in the mundane practical aspects of scientific research.

Frear stated that Swiss workers re-synthesized Zeidler's compound and tested it in 1939. The results of the insecticidal tests were so striking that a Swiss patent was secured in 1940. Subsequent tests confirmed the conclusion that DDT was effective against a wide variety of insects. It was not until 1942 that factual reports of the insecticidal properties of DDT and samples reached the United States. The U.S.D.A. analyzed the material and found the results so spectacular that pilot plant production of the chemical was begun in May, 1943. Production was expanded until in the year 1945 32,998,577 pounds of DDT were produced in this country (40, p. 58).

The primary cause of the rapid expansion of production was the extremely high toxicity exhibited toward many insects affecting man directly. During wartime, when sanitation is a problem, lice, flies, mosquitoes, ticks and other pests multiply rapidly under conditions of military life and wherever masses of people are placed together without proper sanitary

facilities. Such parasites carry many diseases which rapidly reach epidemic proportions. Toxicological studies demonstrated that if used with reasonable precautions, DDT was harmless to man and animals. Another factor which supported rapid development was the scarcity of natural insecticides rotenone and pyrethrum, which were extremely scarce due to wartime shipping difficulties. Frear pointed out that any one of these reasons would have been sufficient to promote the widespread use of DDT. Together they produced a demand which taxed the facilities of Allied chemical industries (40, p. 59).

Frear called Zeidler and his colleagues explorers. This would support the conclusion that they were primarily motivated by curiosity. Frear also stated that Zeidler reported the discovery to his colleagues. He may have done this because of the satisfaction he derived from communication with colleagues in respect to findings, the institution supporting the research may have required such reports, or he may have felt personally obligated to report such findings to future generations so that his work might become a stepping stone to higher achievements. This is speculation, but it appears that all of these forces are at work today in supporting the large number of scientific journals. Professional status appears to be an important factor, though the point would be difficult to prove. Curiosity was probably the primary personal motivating factor behind Zeidler's discovery. He would not have been particularly proud of synthesizing a compound which had no known use, and

few people would have been interested in a compound of no known use, and a compound of potential danger if handled improperly.

The Swiss scientists seem to resemble the scientists in our own experiment stations. They were interested in testing the compound until its characteristics and uses were known. There is no record that they developed manufacturing technologies at that time. The United States Government developed manufacturing technique through pilot plant production. The chemical industry then produced it and sold the compound to the federal Government. Thus, here is a record of one more agricultural resource which was discovered, developed and manufactured in large quantities apart from agricultural objectives. This should be qualified by recognizing that the Swiss scientists examined its agricultural uses. But development through high-cost production stages was accomplished before agriculture began to adapt the compound to commercial agricultural uses.

The study of the motivation of farmers as they have adapted the compound to agricultural production again resolves into production economics. The application of the compound made it possible to produce a given product mix with smaller quantities of a large number of resources, including land and labor. At the lower costs arising out of Government development it probably replaced larger quantities of resources in producing a given output than would have been the case under

strictly private development for agricultural uses. But due to the existing type of agricultural organization and resource use regulation, output has been increased rather than fewer resources used to produce a given product.

One of the most outstanding scientific discoveries in recent years has been the discovery of growth regulative and herbicidal properties of a group of oxy derivatives of acetic acid, the most widely used being 2,4-dichlorophenoxyacetic acid (2,4-D). Work on plant growth regulants at the Boyce Thompson Institute led to the use of 2,4-D for rooting of cuttings, preventing the preharvest drop of apples and other fruit, increasing fruit set and inducing seedless fruit formation, thinning of fruit, regulating the flowering of pineapple, increasing the size of fruit, hastening the ripening of fruit and killing or inhibiting the growth of weeds.

Covering the growth regulating properties of 2,4-D which had been researched by the Boyce Thompson Institute, a U.S. Patent was issued in 1943. In the wording of the patent was a warning that excessive applications of the compound were highly toxic to some plants, but the Institute did not research the herbicidal properties of 2,4-D before a patent was issued to an individual outside the Institute covering the herbicidal properties of the compound and closely related compounds (40, p. 316).

2,4-D is best known for its selective action in controlling weeds in crops, especially cereals, but it has been widely

used, together with 2,4,5-T, also a product of research at the institute, for killing brush and other types of vegetation, including poison ivy. 2,4-D has been used successfully under the direction of scientists at the Institute to kill water hyacinths in Louisiana and as far away as the Congo River in Belgian Congo, Africa (48, p. 3).

The discovery of 2,4-D and its properties is discussed here for two reasons. First, the nature of the discovery illustrates the unpredictability of results in some areas of scientific inquiry. The compound was developed for a use which proved to be the less valuable of two general categories of use. Scientists were looking for compounds which would control certain physiological growth patterns in plants, but the most valuable use has been in either selective killing of plants or in some cases total killing.

Secondly, the type of organization supporting the research leading to the discovery of the compound is of interest here. The Boyce Thompson Institute for Plant Research, Inc., Yonkers, N.Y., was founded in 1924 under a generous endowment by Colonel William Boyce Thompson. Divisions of plant physiology, plant pathology, biochemistry, microchemistry, physical chemistry and morphology were established. The Institute has employed some of the world's outstanding plant scientists, including Percy W. Zimmerman, who did the pioneering work on 2,4-D and related compounds. The Institute cooperates with land grant institutions, other universities, and the U.S.D.A. in conducting

research, and grants fellowships to outstanding young scientists (77, p. 11).

The Institute not only conducts basic research, but it works cooperatively with public and private organizations in developmental problems and in problems of application of plant science technologies to practical uses. Its chief activity, however, is that of basic research in plant science.

Mechanization of Agricultural Production

Mechanization of farm work has accomplished more than substituting machine work for human labor. Mechanization has made possible the accurate application of numerous factors of production, and conversion processes which would not be possible apart from mechanization. Mechanization of basic tillage, reaping and threshing probably did not improve the final product or increase production potential on a given unit of land. But the grain drill with fertilizer attachments makes possible the placement of seed and fertilizer with a degree of accuracy which would not be feasible apart from mechanical systems and thus makes a contribution which farm labor could not duplicate. Modern agricultural technologies depend upon agricultural machinery so completely that they could not stand apart from mechanization.

In this chapter several cases of machine development are discussed as motives and goals supporting mechanization are pursued.

F. S. Mitchell has pointed out that the advent of steam power on which the industrial revolution was based made little impression on agriculture, except for stationary equipment (62, p. 41). The problems arising out of the geographical character of farming made the adaptation of systems of power and systems of power transfer to agriculture very difficult. Steam tractors were so heavy they sank into the ground, and they had scarcely enough power to propel themselves. The only successful application of steam power to tillage was made by John Fowler, an English inventor (60, p. 173). Fowler's system required steam engines at each end of the field being plowed. On each engine was placed a cable drum, and plows were pulled across the field by means of cables. The price of this plowing system restricted its use to a few estate-owners. The price in England was approximately 1,500 pounds (62, p. 11).

The first oil powered tractors began to appear about 1900. The first oil driven tractors shared most of the faults of the steam tractors in that they were too heavy to be used for field work. During the following 15 years, pounds of weight per horsepower was lowered remarkably, and oil tractors became reasonably efficient in tillage operations. Lee pointed out that the demand for oil tractors remained small until the outset of the first world war (60, p. 176). When the United States entered the war on the side of Britain in 1917, a large part of the farm labor force was taken by the army. In order to get farm work done farmers increased purchases of new

tractors such as those being manufactured by Henry Ford. The number of tractors on U.S. farms increased from approximately 10,000 in 1910 to 246,000 in 1920 (62, p. 7).

By 1916 the British government was being subjected to alarming shipping losses. In order to meet her food needs Britain launched a "plowing-up" campaign to bring thousands of acres of new lands into production in order to increase her food supply (60, p. 176). In 1916 there were only 612 oil tractors in Britain and it was not possible to get enough horses to pull the larger numbers of ploughs needed for opening up to cultivation the additional lands. The British government then placed an order with Henry Ford for 5000 oil tractors at a cost of 700 dollars each. The tractors were delivered within five months and were put to work on British farms. The tractors were resorted to as a matter of dire necessity, but Lee stated that neither Britain nor the U.S. went back to horses after the war.

Mechanization of agricultural production was far along before tractors became common. Threshing machines were operated by the cumbersome steam engines until well into the 1920's. Horse-powered machinery provided the main thrust of the agricultural revolution. Numbers of horses and mules in the U.S. increased from approximately 4,896,000 in 1850 to a peak of approximately 26,500,000 in 1915 (62, p. 12).

The industrial revolution provided the means of development of technologies necessary for production of good quality

steel, gears, shafts, pulleys, cranks and other components making up agricultural machinery. In fact the first agricultural machinery of the 19th century was designed by farm craftsmen and constructed from components available from non-agricultural industry. The development of the reaping machine provides an example.

Lee stated that by 1828 four patents for reaping machines had been taken out in Britain. The first practical reaper was built by Patrick Bell and his brother on a Scottish farm. The machine apparently was quite successful, but Bell did not take out a patent for his reaper. He wanted his invention to benefit humanity by lightening the toil of the farm laborers of his day, but he did not want to make money for himself. Bell later became a Presbyterian minister. By 1832 ten copies had been made from Bell's reaper and two traveled as far as Australia. Bell's reapers were eventually manufactured by a number of firms, and in 1868 the Highland and Agricultural Society presented the inventor with a gift of 1000 pounds in recognition of his great service to agriculture. Here is a very clear case of basic technological development by non-agricultural industry, and of machine design and development within agriculture. The latter development in this case was supported by the altruistic motive.

The American reaper which gained wide acceptance was also constructed of wood and odds and ends of parts from non-agricultural industry. But there are few signs of altruism as a

primary motive supporting development. Cyrus McCormick entered into costly law suits in order to protect his patents. This would point to an economic motive. McCormick manufactured his reapers on a large scale (60, p. 156).

The societal push behind the adaptation of the reaper in America was directly connected with the labor shortage on farms in the North arising out of the Civil War. Again, necessity led to the rapid adaptation of a farm machine, which apart from the war situation would probably have been adapted more slowly and gradually to agricultural production. The Northern Secretary of War was recorded as having said, "The reaper is for the North what the slave is for the South. It releases our young men to do battle for the Union, and at the same time it keeps up the supply of the nation's bread" (60, p. 160).

Earl O. Heady pointed out that mechanical innovations have had their greatest effect in increasing labor productivity, and serving as a substitute for labor (46, p. 67). He cited three forces supporting mechanization in agriculture: (1) The inventiveness of agricultural engineers, (2) the high cost of labor relative to machinery, and (3) the favorable income position of farmers in postwar years.

Heady pointed out that some capital invested in farm machinery must be classified as consumption expenditure. In other words, some machines are purchased to eliminate drudgery or for convenience rather than for the reason that costs are reduced by replacing labor in some enterprise. Heady pointed

out further than empirical data derived from a prosperous farming area of northern Iowa in 1950 indicated that the average marginal value productivity of annual machine expenses for \$1.00 input was \$.93. Crop services showed an average marginal return of \$1.08 for \$1.00 input (46, p. 72). Farmers seemed to be adapting a considerable amount of machinery for purposes of convenience. Farmers tend to adapt machinery to farm production for such reasons as convenience chiefly during periods of favorable farm incomes.

Basic Research in Plant Breeding and Development of More Productive Plants

The reader should be aware by now that only a small sample of new technologies is being considered, but they appear to the writer to constitute representative cases from the standpoint of their impact upon agriculture. Livestock breeding could be considered. Hybrid lines of chickens and other developments have produced dramatic feed efficiency gains in poultry enterprises. Feed efficiency in swine production has increased dramatically due both to breeding and nutrition. Beef breeders are beginning to take cognizance of feed efficiency.

The hybridization of plants has resulted in dramatic increases in productivity and/or quality in cases of corn, fruits and vegetables, and sorghums. The current development in this area is that of hybridization of wheat. Leaders around

the world are observing this drama with varied viewpoints. A brief discussion of this discovery and probable developments will further illustrate goals set forth at the beginning of the chapter.

Two discoveries made the hybridization of wheat possible. J. A. Wilson and W. M. Ross of the Fort Hays Branch Kansas Experiment Station made the first discovery--that Triticum timopheevi is an effective source of male sterility in crosses with common wheat (11, p. 46). The discovery of fertility restoration was reported by J. W. Schmidt, V. A. Johnson, and S. S. Maan at the University of Nebraska. The research at Fort Hays and Lincoln was based most directly on the earlier work by Kihnsra and Fudasawa in Japan, according to Schmidt (11, p. 46). But he emphasized that many scientists have been working on the problem for a long period of time. A large number of possible parents for the hybrids will be available as soon as the male sterilizing element and the restorer can be bred into a variety. The U.S.D.A. has seed for more than 17,000 varieties of wheat of known genetic and growth characteristics (11, 140). Pertinent data describing the performance and characteristics of these varieties are recorded on IBM cards.

The scientists expect that several years will be required to develop parent varieties with desirable milling characteristics. The development time for feed grain hybrids was less due to the fact that feed grains are intermediate resources; that is, they are fed to livestock. Nutrition and palatability were the chief factors. More problems must be overcome in the

development of desirable wheat hybrids, but the genetic tools are now available for developing such hybrids for commercial use.

In February, 1963, Fort Hays Branch Kansas Experiment Station offered seed of the male sterile Bison wheat developed at Fort Hays to plant breeders (34, p. 10). It was reported that there was active demand from commercial breeders, universities and foreign governments.

When J. W. Schmidt of the Nebraska Experiment Station was asked in an interview what his feelings were when he knew that he and his colleagues had discovered a complete genetic system for hybridizing wheat, he replied, "As plant breeders we were pleased, but then when we looked at the two year's supply of surplus wheat that is crowding our available grain storage space, we wondered When we consider, however, that America is a well-fed island in a hungry world, we think this discovery will be of real value" (11, p. 141).

In his statement Schmidt expressed pleasure at success in scientific achievement for its own sake. This is still apparently a strong personal motive. Professional status and competition in the highest sense are strong motivating factors within and among scientific disciplines today. However, this motive is not separable from the curiosity motive. An individual scientist cannot know precisely which personal goals support his interests in inquiry. Secondly, Schmidt expressed an awareness of the probable economic and social impact of the

discovery in the grain exporting countries. This awareness is not always the property of the scientist. In any case scientists rarely ask themselves if society is mature enough to make the highest use of their discoveries before releasing them. Findings are released, and institutions of society subsequently face the necessity for reappraisal of their functions in the light of new knowledge. Thirdly, Schmidt expressed a sober concern for the nutritional needs of people of under-fed nations. This is clearly more than a rationalization of production increasing technologies in the presence of surplus commodities. It is an altruistic motive. It is the task of policy makers around the world to work out an effective pattern of production and distribution. Scientists are providing them with the needed production possibilities. Production possibilities more than sufficient for feeding all the people of the world cannot be deplored in the same manner as military means more than sufficient for killing all the people of the world.

The Development of Atomic Energy

As the agricultural production function becomes affected by atomic fission it seems appropriate to comment briefly upon the course of development of this technology. In his book Atomic Energy for Military Purposes Henry DeWolf Smyth described the course of atomic energy development from the hypothesis of the equivalence of mass and energy to the explosion of the first atomic bomb in New Mexico on July 16, 1945 (90).

Smyth pointed out that as early as 1905 Einstein suggested that proof of the equivalence of mass and energy might be found by a study of radioactive substances. "He concluded that the amount of energy, E , equivalent to a mass, m , was given by the equation $E = mc^2$ where c is the velocity of light. If this is stated in actual numbers, its startling character is apparent. It shows that one kilogram (2.2 pounds) of matter, if converted entirely into energy, would give 25 billion kilowatt hours of energy. This is equal to the energy that would be generated by the total electric power industry in the United States (as of 1939) running for approximately two months. Compare this fantastic figure with the 8.5 kilowatt hours of heat energy which may be produced by burning an equal amount of coal" (90, p. 2).

The worker in the social sciences is greatly impressed with the physical possibilities from atomic energy development, but equally impressed by the potential in mobilization of intellectual and material resources on such a scale. Smyth pointed out that in March, 1939, uranium fission was discovered (90, p. 54). The theory underlying the process would have ordinarily been developed over a period of decades. But by the summer of 1940 the National Defense Research Committee had been formed and was recruiting qualified scientific personnel. Five years later, after an expenditure of \$2 billion the first bomb was exploded. Three small cities had been constructed in the process and a vast complex of laboratories

and engineering works built.

In 1950 Sam H. Schurr and Jacob Marschak made an attempt to place the commercial potential of atomic energy in proper perspective (84, pp. 124-134). The only agricultural resource whose possible production costs from atomic reactor powered generating systems was considered was that of phosphate fertilizer. It was mentioned previously that the most common method of rendering the phosphate ion available is that of treating rock phosphate with sulfuric acid. However, a more concentrated product called double superphosphate is now produced in Florida by the electric furnace process. Phosphate rock is smelted to produce elemental phosphorus. The elemental phosphorus is then made into phosphoric acid which is used to treat rock phosphate as described previously.

After estimating the kilowatt hour costs of electricity which would compete with the sulfuric acid process, the authors concluded, that costs of the electric furnace method powered by atomic energy might be on par with costs of existing production processes in some situations and localities. The reader interested in this conversion problem should study the reference plus other more current estimates.

Today atomic powered generating systems are competitive with existing systems in some high-cost regions. It appears that within three or four decades electricity so produced will be competitive with electricity produced by older methods in all regions. The period of development for peaceful uses of

atomic energy is many times as long as the Manhattan project. The goals involved are being approached by means of existing technologies.

Agriculture has benefited from the mass-energy conversion process in other ways. In 1945 radioactive carbon was supplied to biochemists for use in tracing carbon through the photosynthetic formation of carbohydrates, proteins and fats in plants. Radioactive isotopes of other nutritional elements have since come into common use in studying plant nutrition and physiology.

The development of atomic energy provides another example of accomplishment arising out of the quest for a war potential norm. Controlled fission was only a step away from uncontrolled fission, and the impact of the discovery and development of the controlled reaction and peaceful uses for the uncontrolled reaction cannot even be imagined. The science of agriculture is being basically changed by the new knowledge of energy-mass relationships. Scientists are now hoping to discover means by which the fusion reaction may be controlled for further exploitation of energy sources, such as heavy hydrogen from sea water. Complex conversion processes requiring large amounts of cheap energy will ultimately become practical. Some of these will change the science of agriculture, while some will substitute for agriculture.

Education as a Technology and a Goal

Mass education is a goal unique to modern societies. It is also inseparably associated with technological discovery, development and adaptation. Since the concept of mass education sprang out of a predominately agrarian society, it is not surprising that the curriculums offered in land grant colleges were at first primarily oriented to arts and crafts of interest and of use to agricultural communities.

In order to provide for training in agricultural arts and sciences, mechanical arts, English and general sciences, Congress passed the Agricultural College Act of 1862 (110). This Act provided for grants in aid to states for purposes of establishing such colleges. The first grants were in land, but in 1890 money appropriations were provided. In 1887 Congress provided for the establishment of experiment stations (111). By 1914 Congress had determined that the means of dissemination of information valuable to farmers and rural communities were inadequate. In 1914 Congress provided for the establishment of the Cooperative Agricultural Extension Service (112). The states then had colleges offering resident instruction including instruction in agricultural arts and sciences, they had experiment stations in which agricultural problems could be researched, and they had a means for disseminating the information among rural people. In 1917 Congress passed the Vocational Education Act which provided federal funds to high school districts which would offer approved training in

vocational agriculture to farm boys (113). This training was later extended to include veterans of World War II and the Korean War. Many communities also developed young and adult farmer classes on a long-term basis.

Within the educational system there is a built-in value judgment which holds that a more complete knowledge of the environment is a desirable end in itself. This value judgment is a part of the American culture and it permeates the entire educational system. This allows research to proceed along lines not directly in accord with an observable end in view or goal other than that of acquiring a more complete knowledge of the environment. The course of research might not even be envisioned outside the university laboratories, or private laboratories where inquiry is motivated primarily by educational objectives.

The more practical concepts of higher education and research which hold that education and associated research are not ends in themselves are easily integrated with the purely educational goals by including one assumption. This is the assumption that any knowledge of processes of nature, human personality and human relationships will lead ultimately to ability to regroup physical, biological and human resources to facilitate progress toward virtually any goals man might choose to achieve. The result is that universities not only disseminate what is known, but they progress toward ever widening horizons through research.

A practical evidence of this quest for basic knowledge in colleges and universities is the fact that during 1963 colleges and universities will perform 50 per cent of the basic research in the United States, measured by funds spent for that purpose (79, p. 21). Except for a relatively small amount of government restricted information the results of this research become available to all who will inquire, including enemy societies. The result is a wide diffusion of knowledge.

Education is a technology. The improvement of pedagogy and research methods is a never-ending quest. Robert G. Picard, research and development director for a laboratory instrumentation firm, believes that the genius of creative scientists can be made to yield more valuable technologies by automating the laboratories (74). Picard stated that, whereas in one case the aim of automation is to reduce the total number of man-hours required for the production of a product, the laboratory aim is to increase the number of man-hours available for creative scientific thinking and study. Picard pointed out that too many laboratory techniques have not changed substantially from those developed by the first scientists.

Automation of laboratory research is progressing in some fields. Hydrological problems, electric circuit problems, and some problems of chemical analysis are solved on computers. The fact was mentioned previously that the U.S.D.A. keeps characteristics of thousands of plants on IBM cards, making

possible theoretical genetic synthesis in plant breeding (11). Problems involving constant operator evaluation, such as microscopy, have not yet been automated to a high degree.

As institutions and physical facilities permit larger numbers of persons to attend universities, the entire system expands. More instructors are trained along with persons trained in commercial aspects of technologies. More graduate students develop research skills by actually participating in basic research, aspects of development, or problems of adaptation of technologies. The prospects are that the educational system will turn out a continuing flow and an increasing flow of new technologies. The basic curiosity motive may then be more fully exploited.

Out of the educational institutions come new technologies which change patterns of production and consumption. Old factors are replaced by new, and old techniques are replaced by new, so that over a period of time complete technologies are replaced. But education also has a profound impact upon resource use within one production period, such as a crop year. Within one production period education effectively transforms technologies based upon given physical and animal resources. Knowledge of interrelationships among factors under changing environmental conditions, combined with creative thinking habits, significantly affects the quantity and quality of product forthcoming from some given set of resources. Knowledge and creative thinking habits affect the magnitude of

profit from use of given resources within the firm setting. Knowledge and creative thinking habits facilitate long run adjustment of the firm, labor and family to aggregate trends affecting the firm. Education creates new technologies which replace the old, and education transforms existing technologies through dissemination of knowledge and through developing creative thinking habits.

Discovery and Development of Technologies for Contingency Reserves

Within the United States there has long been at least a dim outline of a productive capacity contingency reserve goal. This goal cannot be adequately evaluated by discussing the course of development of any one technology, so it will be discussed in reference to a number of agricultural technologies.

Whether or not by design, the United States economy has long had to deal with large reserves of productive capacity in most areas of industry. During brief periods of war these reserves have been called into use, but during more quiet times they cause production control problems among intensely competitive industries, such as agriculture. But in spite of assurances of adequate productive capacity provided by surplus commodities, exports based more on humanitarian principles than economics, and a reservoir of unapplied technology, uncertainty remains. Just as civil engineers design bridges

according to precise stress requirements and then multiply the strength factors by some quite unscientific safety coefficient, agricultural economists do not wish to be found foolishly over-optimistic at the outset of some emergency situation.

Uncertainty is still very much a part of the agricultural production function. Louis M. Thompson recently reminded agricultural leaders how much agriculture still depends upon old-fashioned weather, for example (98). Many of the new technologies function efficiently in the conversion processes to which they contribute only when moisture and temperature are not severely limiting. Thompson refined analytical techniques used in identifying weather-production relationships by taking into account the time distribution of rain fall and temperature in relation to the critical growth requirements of plants, and interactions between temperature and rain fall. When it is observed that weather conditions during the first one-half of the 1950's were rather unfavorable for maximum possible corn and soybean yields, and that weather conditions during the period from 1956 to 1962 were generally quite favorable for production of these crops, one can only conclude that we might have overestimated technological gains during the period.

Thompson pointed out that to include productivity attributable to weather conditions in technological trends during the 1950's is to assume that weather will continue to improve in the future at the same rate as during those years, if those

trends are projected into the future. Thompson concluded that the study indicated that the continued build-up of the feed grain surplus after 1957 was associated with better than average weather. "This concept is in contrast to the belief that an 'explosion in technology' occurred in the decade of the 1950's" (88, p. 31).

J. Carroll Bottum has estimated that 80 million acres of the poorer land in cultivation in the United States would need to be removed from production before supply of agricultural commodities would equate with demand in an unregulated market at reasonable prices (7, p. 68). Subtracting this figure from the nominal total in cultivation, 450 million acres, leaves 370 million acres in cultivation. Present trends point to a need for even fewer acres by 1975. But in 1952 Bryon T. Shaw estimated from a number of studies of future needs that to provide an adequate diet for all citizens of the United States by 1975 would require 627 million acres of cropland if productivity gains from 1935-39 to 1950 were projected to 1975 (86). Shaw submitted an urgent plea for research workers, educators, legislators and the public as a whole to step up the tempo of research and increase the productive capacity of the nation.

During the same period Sherman E. Johnson concluded from a summary of studies that gains in productivity would probably increase at a more rapid rate than the average from 1935-39 to 1950, but he estimated that we would still need 35 to 40

million additional acres of crop land by 1975 (54). Johnson, also, emphasized the need for increasing the tempo of research in order to meet the nutritional requirements of population projected to 1975.

Both Shaw and Johnson suggested building a contingency reserve of production capacity in the nature of technology which could be drawn upon in case of emergency. In our system of agricultural organization it is difficult to keep these new technologies from being applied. As will be pointed out later, the result of the application of the technologies is a substitution for traditionally used agricultural resources. The reserves are then held in the form of excess capacity in land and agricultural labor. Society attempts to assist in maintaining some semblance of usefulness in regards to these resources until they can be applied to other productive activities. In a highly competitive sector of the economy it is difficult to hold large reserves of productive capacity out of use.

The contingency reserve goal is a part of the defense goal. In the event of an enemy attack a large part of our productive capacity might be destroyed or contaminated. Sidney W. Fox (36) believes that technologies should be developed by which large supplies of cheap chemical compounds could be converted into nutritional components. These chemicals, in this case, would form the contingency reserves needed mainly in case of war.

Reserves are also required for assisting other nations in times of emergency. Assisting nations in economic development problems requires a capacity to produce more food than markets will absorb at reasonable prices.

In our market economy the holding of contingency reserves in the form of unapplied technologies, agricultural labor and/or agricultural land are increasingly viewed as the responsibility of the society as a whole. Improving institutional means of holding these reserves is a subject discussed farther on.

Trends in Food Production Technologies

There are two trends in food production technology, in general, which should be closely observed by agricultural policy makers. One trend is moving toward the addition of nutritional components to plant sources with the objective of creating nearly complete nutritional sources. Work is being carried on to upgrade grain diets by addition of chemically derived nutritional components. In another area work is being carried on to render plant proteins of high quality, such as soy bean protein, comparable to animal protein sources in nutritional value, color, flavor and texture. Nutritional value and palatability are the foremost objectives, however.

A second trend is moving toward the creation of nutritional components through direct chemical synthesis. This is definitely a long run trend in the case of carbohydrates, but

in the cases of synthesis of vitamins and amino acids the technologies are developing rapidly, reaching stages of adaptation to production and consumption in some cases.

Substitution of plant proteins for animal proteins on a significant scale will affect the demand for meat and dairy products. Substitution of relatively cheap chemical resources for nutritional components from natural sources will further affect demand for agricultural products.

There is a tendency for professional people to discount probable validity of reports pertaining to progress in food technologies found in the popular publications. This heavy discounting of such reports without inquiring into food technology journals and journals of biochemistry could result in unpreparedness as "break-throughs" occur in nutritional component synthesis. This danger could be especially imminent due to the probable lack of dramatic "break-throughs". New food technologies are progressing chiefly through slow but methodical research. Only relatively small investments are being made in this field presently, but there are indications of a slow but continuous progression of new food production technologies forthcoming. These technologies are of interest to the agricultural economist in part because demand for agricultural products is vitally affected.

This chapter provides a brief outline of the present state of food technologies and trends. A more comprehensive report, kept up to date, would be useful to agricultural economists.

Ross Talbot, professor of history and government at Iowa State University, has suggested that the Department of Agriculture (U.S.D.A.) be renamed the Department of Food and Agriculture, and its organization and activities reoriented therewith (97). Talbot suggested several reasons why this change should be made, but the change would be justified merely upon the basis of past and impending changes in the means by which the nation obtains its food supply, clothing and shelter and in the means and form of utilization. A paper given at the 1962 annual conference of the Institute of Food Technologists by George W. Irving, Jr. and Sam R. Hoover supports the conclusion that the U.S.D.A. is presently conducting many varied kinds of activities related to food and fiber which could not be classed under the heading "Agriculture" (52). Irving and Hoover, associated with the Agricultural Research Service (A.R.S.) of the U.S.D.A., pointed out that food science, space science, and medical science intertwine and require basic studies in many disciplines for eventual success in the corresponding applied technologies. Research in governmental laboratories has always included strong elements of basic research, and some of the classical studies have been made by men working in government laboratories. The authors stated that the Department is strong in biochemistry of plant and animal systems, their composition, properties, and behavior. One strong phase of research is in utilization. In the Utilization Research Division major areas of recent research

have included studies of seed globulins, of their subcellular distribution, and of a specific group of enzymatic proteins, the lipases. The A.R.S. has recently (1957) established pioneering research laboratories to which go about two per cent of the research funds available to the A.R.S. Each consists of a few senior scientists with technical assistants, who are permitted to carry out unprogrammed research in a broad field. Irving and Hoover reported that, despite the relatively short time these laboratories have been in existence, their success appears to have fully justified the concept.

Such basic research not only leads to basic changes in agricultural production and farm-produced food processing, but a significant part of the research paves the way toward methods of food production which are fundamentally different from traditional agricultural methods. The development of hybrid plants could hardly be placed in this class, but the food production potential from a unit of land and labor is dramatically increased. The development of increased nutritional quality by fermentation processes departs from traditional utilization technology. Mariena culture (the term seems to belong to Fox) (36), definitely departs from traditional methods of obtaining the food supply. Outright chemical synthesis of nutritional components is the most dramatic and fundamental departure from traditional food production and preparation.

Hajime Kadota, professor at Kyoto University, Kyoto,

Japan, has reported a development which falls into the category of mariculture (55). He reported that Japanese fishing areas have gradually been lost through indiscriminate fishing and water pollution from industrial wastes and urban populations. The Research Institute for Food Science at Kyoto University is conducting research involving cultivation of fish, prawn, oyster, and other mollusks. Kadota believes that in the future Japan will depend mainly on cultivation rather than catching. Some kinds of fish cultivation are already yielding a greater proportion of total supply than catching. In the foreseeable future, the large majority of fish produced in Japan will probably be produced in farming plants. Prices are expected to be lower than at present.

The chief problem encountered by Kadota and his associates is that of providing a supply of minute planktons to be fed young fish in larval stages. Too small to be harvested with plankton nets, they must be grown. Research is being carried on in mass cultivation of these organisms. In the course of the research it was discovered incidentally that some of these planktons synthesize a flavor which is highly relished in Japan. Thus some planktons will become useful not only as feeds for fish but also as a direct food resource.

In some types of research food technologists allow their minds to range freely all around an almost infinite number of nutritional resource possibilities. Instead of thinking in terms of pounds of red meat, marine food, grain, etc., they

think in terms of atoms, molecules, bacteria, rats, etc. The object is to furnish the nutritional requirements of man. In the most unlimited approach everything else down to the smallest units of matter and energy with which men may work remains variable. Limitations gradually fall into place as some hypothetical syntheses become impossible under foreseeable technology, or not feasible. Still other limitations come into play when problems of human ingestion are considered. Acceptance of novel sources of nutrition is another limitation. As long as consumers are relatively free to select and utilize the food sources of their choice, all of these limitations seem to be relevant. However, there are situations and conditions under which human beings are not free to choose what they desire or perhaps to utilize what they desire. It is under these situations that new sources of foods become developed. Once developed, however, it is sometimes feasible and economical to modify their characteristics to increase efficiency of ingestion, acceptance or otherwise remove limitations.

One example of a situation in which the human has only limited choice over the type of food he will consume is that of space flight. Paul A. Lachance and John E. Vanderveen are conducting research in space foods and nutrition at the Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio (57). Instead of thinking of beef cattle or carrots, for example, they are thinking of (1) bacteria and

(2) vegetable tissue grown in culture. One of the problems is that of developing technique for utilization of waste for biological food regeneration to supplement on-board food supplies. This would extend mission duration. Biological entities, such as hydrogen fixing bacteria, capable of utilizing carbon dioxide and the energy-rich hydrogen produced in the electrolysis of water are under consideration for producing food in the form of bacterial protoplasm. In fact this research, purely hypothetical a few years ago, is now in progress. The closed bioecological system would be divided into three compartments, according to Lachance and Vanderveen: (1) the man and animal compartment; (2) the sewage-disposal compartment; and (3) the photosynthetic gas-exchange compartment. The animals would be included to convert plant material into food products. Examples of possible nutrient converters are *Daphnia*, which are 40% efficient in converting algae into tissues, small fish, rats or perhaps chickens. The rat is particularly well suited because of its ability to efficiently utilize algae supplemented with amino acids as the sole source of protein. The fungus *linderina pennispora* has been considered because of its efficiency in converting ammonia into fungal protein. These researchers believe that it is possible that developments in this area of space foods may have world implications in man's quest for solutions to present and future food problems.

R. R. Williams looks at the problem of providing food to

underdeveloped nations chiefly as one of dietary supplementation (135). Williams pointed out that most dietary deficiency diseases are caused by a lack of certain amino acids and vitamins in the diets of grain consuming people, and sometimes by the lack of certain fatty acids in the diet. The problem is not often a lack of carbohydrates, but if sufficient grains were used to produce the required proteins, not enough carbohydrates sources would be left to satisfy energy requirements or to fill the stomachs in some regions. The costs of proteinaceous foods is prohibitive relative to income in most of the countries in which large numbers of people suffer from dietary deficiencies. There is a possibility for underdeveloped nations to provide adequate supplies of grains to their growing populations if diets can be upgraded without expensive animal proteins. Williams believes that the production of sources of major food energy will be the task of traditional agriculture for a very long time, in part because these components are used in such large quantities.

In 1954 Mordecai Ezekiel defined the dietary needs of most of the under-fed as improvement of quality rather than quantity (33). Special attention was being given by the Food and Agricultural Organization of the United Nations to the possibilities of producing nutritional supplements which would effectively upgrade grain diets. Ezekiel felt confident that the carbohydrate needs of all people could be met, and that in fact grain surplusses were showing up in an increasing

number of countries. The pockets of carbohydrate starvation were apparently caused by institutions which inhibited effective distribution of grains and grain products.

Karl Fox has pointed out that very few people in the world are anxious to increase their per capita consumption of cereal products, yet the great bulk of our surplus is in the form of carbohydrate sources (35). He pointed out further that if our grain were given away at the bin sites in Iowa and Kansas, the total cost of the conversion to proteinaceous foods would still be too expensive for most peoples of the world.

Research by Williams and others has indicated that the disease, kawashiorkor, is correlated geographically with low consumption of animal proteins (9). The animal proteins are characterized by a higher content of certain of the eight amino acids essential for proper human nutrition. In general vegetable proteins tend to be lower than animal proteins in lysine, tryptophan, methionine, and perhaps threonine. Williams has published the 1956 costs of preparing these amino acids along with dietary requirements. In 1962 Sidney Fox compared William's cost figures with his own current cost figures (36, p. 24). Those figures are presented in Table 1.

The reader interested in further details would profit by studying the references. Comparative costs were given for all eight of the amino acids known to be limiting in diets of humans. The annual requirements for people of various ages and conditions were given by Williams. The projected costs in

Table 1. Adult requirements and manufacturing costs of three amino acids

Amino acid	Price 31 Dec. 1956	Price 22 Jan. 1962	Projected cost in large-scale man.	Annual adult requirement
L-lysine HCl	\$.075 g.	\$.010 g.	\$.0044 - .0077 g.	292 g.
DL-methionine	.006	.003	.003	366 g.
L-tryptophan	.49	.42	.01 - .019	102 g.

large-scale manufacture assume known technology. The range is not given for methionine because this amino acid is being manufactured on a fairly large scale today and is used to upgrade the quality of some livestock feeds. Notice that for methionine the present cost and the projected cost are the same.

Williams also presented vitamin requirements and costs of preparation of supplemental vitamins, pointing out that in some parts of the world diets are deficient in certain vitamins. Fox brought the economic statistics presented by Williams up to date. Fox pointed out that in commercial quantities the cost per person for annual requirements of Vitamin A, Thiamine, Riboflavin, Nicotinamide, Ascorbic acid, Calcium pantothenate and Pyridoxine would amount to a sum of approximately 55 cents in 1962 (36). These are the vitamins commonly used in tablets as nutritional supplements. These costs of production in large

scale do not include costs of distribution.

Fox agreed with Williams that chemical synthesis of nutritional components is the most satisfactory long-run means of satisfying the nutritional needs of people for amino acids and vitamins, but he went a step further and speculated that in the future the synthesis of carbohydrates might prove feasible. Fox stated his rationale briefly as follows (36, p. 23):

In a long-term sense, the control of production of nutritional molecules by manufacture from other molecules seems almost to be an inexorable development. We have seen such development in hormones that are more economically prepared by synthesis, in the field of fibers, some of which are superior to the natural materials, and in a number of other areas of manufacture. Moreover we must recognize that we are already well within the era of synthetic foods, particularly since nearly all of the vitamins, for example, are prepared more economically and abundantly by synthesis than by isolation.

Presently, synthetically derived amino acids are sometimes used to supply the entire amino acid requirements in cases of high-cost intravenous nutrition, and as pointed out above, costs of supplemental quantities of amino acids likely to be deficient in grain diets would be economically produced on a large scale production basis. However, there are still some problems involving efficient digestion of ingested amino acids. Most of the forms in which amino acids are presently most economically produced are not efficiently digested by the human digestive system in free forms. Proteins from natural sources release amino acids in a nutritionally effective and efficient progression, whereas the human organism accommodates

poorly to rapid ingestion of free amino acids. This problem is circumvented when intravenous nutrition is resorted to rather than ingestion of amino acids in free form. Dr. Fox points out that pansynthesis offers considerable hope for producing amino acids both more economically and in more desirable combinations and forms. On the basis of recapitulationist theories of molecular evolution, the possibility of producing mixtures in nearly natural proportions holds considerable promise, and some studies seem to support the theory.

Williams does not believe that betterment of agricultural practices alone can meet the needs of a growing world population, and Fox seems to accept this thesis. Williams believes that population growth will be controlled as the standard of living and of education is raised, as has been the case in several western countries and Japan. But he believes that, until that time comes, manufacturing chemistry must be called upon to aid agriculture by producing synthetically and selectively those essential components of food which are required in relatively minor amounts, such as vitamins and amino acids.

At the level of basic research scientific inquiry into biochemical processes is frequently unlabeled as to potential use. For example, one may read The Photosynthesis of Carbon Compounds by Melvin Calvin and J. A. Bassham and find no word about practical uses for this research throughout the entire book (10). Calvin began studying the reactions used by photosynthetic organisms in 1935. The studies were expedited

through the discovery of long-lived isotopic carbons in 1940, for by using these isotopes, the path of carbohydrate synthesis could be followed and studied. In 1945 radiocarbon isotopes became available in large amounts as a product of nuclear reactors. The sequence of products resulting from carbon reduction during photosynthesis was then discovered by Calvin and others, and the remaining objective presently, is to check the validity of the cycle, investigate details of its mechanism, and to establish its quantitative importance.

We can summarize the over-all conversion of light energy into chemical energy in the form of carbohydrate and oxygen by several steps. First, the light energy absorbed by chlorophyll and related pigments is converted into the high chemical potential energy of some compounds. Second, these compounds react with water and produce oxygen and good reducing agents as well as other cofactors containing high chemical potential energy. Finally, these reducing and energetic cofactors react with carbon dioxide and other inorganic compounds to produce organic compounds (10, p. vi).

The second and third reactions are thought to be "dark" reactions. It is at this point that Sidney Fox would seek to synthesize carbohydrate materials. He points out that possible courses for synthesizing carbohydrates, proteins and fats may be worked out from knowledge of nature's synthetic pathways. But he believes that a much more simple process may be discovered first. This simplified process might resemble the last step in the natural process, although Fox does not state this explicitly. But he suggests the hypothesis that the fixation of carbon dioxide to certain aldehyde derived compounds might produce carbohydrate materials. He feels that a

more direct way might provide an economical answer and lead to a chemical conversion of cheap chemical reactants which could be stored in a safe place and used after a nuclear holocaust.

Alfred E. Harper has stated that future developments in nutrition cannot be discussed independently of future developments in science and technology generally, in medical science in particular or in isolation from sociological, economic, or even political developments (44). All reputable food technologists are fully aware of the importance of medical science, manufacturing technology and related science to the evolution of food technology. But the latter part of Harper's statement should be qualified. Certainly a crash program aimed at developing food technology would call for a sociological, economic and political synthesis as well as biochemical synthesis. The mobilization of vast resources for the purpose would resolve into a political issue of no mean importance. But a more leisurely approach to the biochemical-medical-technological studies may proceed under usual state and federal funds in university laboratories, under private funds in private and university laboratories, and under such programs as space science and technology and defense technology. This approach might be expected to carry nutritional component synthesis a long way toward commercial and domestic significance. As studies are tied with one popular theme or another and this research grant and that, eventually a complete

technology will probably evolve.

Harper insists, however, that man's food habits and tastes will not change rapidly. Man learned millenia ago that roasted meat was highly palatable, that crisp fat gave him a feeling of satiety, and the fresh ripe fruit was highly refreshing. Such products will be displaced only by necessity, he insists, not by choice. A study of the acceptance of novel foods by David R. Peryam for the armed forces quartermaster research and engineering command seemed to support Harper's hypothesis (73). The study revealed that food habits in individuals or in a culture tend to be resistant to change, but that the general principles of learning can still be expected to apply. Voluntary changes in food habits and associated patterns of eating occur frequently but the changes are usually not basic.

Fox stated that some of the synthesized amino acid combinations concocted in the laboratory didn't taste badly to most people. Loren B. Sjostrom has suggested that there is reason to believe synthesized foods or low-cost food from new sources might actually taste good to most people (36):

Some of the new products will probably be introduced as novelties at first, substituting for natural products that are difficult to store, handle, or pack at certain seasons. But because many of the manufactured products will be superior to natural products, there is good reason to believe they will gain rapid acceptance as standard items.

It is important to recognize that the technologies of flavor, color and texture are advancing right along with those of basic nutritional components. In this area the past is not

an accurate guide to the future.

At least one company is presently extracting highly concentrated protein from soybeans, spinning it into fibers, processing it to remove toxicity and undesirable flavors, then processing it into textures similar to a number of meat products (Worthington Foods, Inc., Worthington, Ohio). Appropriate flavors and colors are added in this process. The company is presently marketing a chicken style roll and a ham style roll among other variations. As amino acid technology advances and the required advances in nutrition are made, such vegetable protein sources will be made nutritionally comparable to proteins from animal sources.

The science of food technology is but an infant at the present as compared with most other sciences. W. H. Cook, associated with the division of applied biology at the national research council in Ottawa, Canada, believes that food science, compared with other sciences has lost ground during the scientific revolution, and that its state of preparedness for the future is endangered by a lack of adequate basic research (22). Most universities rarely give food science a status higher than departmental, and resources are quite limited in most cases. Governments have departments of agriculture and health, but only branches of these departments deal with foods, and much of their effort is routine rather than research. In the United States the food industry spends only about 0.2% of its gross sales on research and develop-

ment (22). Most other manufacturing industries that yield comparable returns on gross assets spend many times that much.

When the possible economic impact of developments of food technology are considered, arguments concerning whether or not people will completely replace traditional foods with new foods when they are not forced by circumstances to do so is a fruitless argument. When the very low price elasticity of demand for food products is considered, it becomes apparent that even moderate acceptance of new foods not based on agriculture would have severe depressing effects on prices of farm commodities replaced. Difficulties of regulating food supply in the United States would increase. Continued support of agricultural prices at high levels would tend to increase the rate of substitution of new foods for traditional foods.

The person who persistently maintains that he will always prefer beef to a synthetically produced food probably eats some processed and compressed lunch meats. These meats often have flavor, texture and color properties all their own. There is nothing "natural" about them. Cheese is not found in nature. Most canned foods differ from their fresh counterparts in color, texture and flavor. It therefore seems certain that new foods will replace at least a small proportion of natural foods within a short time after marketing, generally. This small proportion could make adjustments in agricultural resource use much more urgent.

When the time comes that a widely accepted plant protein

appears on the market, fortified with certain amino acids and vitamins to make it nutritionally comparable to high grade animal protein, a significant substitution for meat will probably occur if the price differential is considerable. Moderate income families could be expected to substitute the new product for meat served perhaps one meal each day, while serving traditional proteins the remaining two meals. Low income families might reserve more expensive meat for special occasions. High income families might be expected to consume some new protein source because of convenience features.

The savings to consumers arising out of the use of a cheaper carbohydrate source than wheat would probably not be very attractive. But as a livestock feed such a carbohydrate source might gain considerable acceptance at a significant cost differential. Problems of acceptance are not as difficult in this case, provided the flavor of the livestock product is pleasing. It can also be expected that amino acid supplements will gradually begin to compete with plant protein in livestock feeds as amino acid technology develops, and as nutritional problems are solved.

Slow acceptance of new foods, and even new feeds, provides an economic shock absorber, in effect. While people are tasting, smelling, contemplating and increasing substitution only at a slow rate, time is provided during which traditional resources may adjust without great hardship to owners, provided programs aren't devised to isolate agriculture from the new

forces. Additional adjustment time is usually gained due to the initial high cost of production of a new food item. Slow acceptance and initial high cost of production interact to provide considerable adjustment time in most cases. New cost reducing technologies utilizing land and agricultural labor will continuously increase the competitive position of traditional food sources, also. But these new technologies may also replace some land and labor.

In summary, it may be concluded that the curiosity motive is the primary motive underlying basic research and is the most readily observed motive. Other motives are not easily distinguished from one another, but altruism has been an important motive among scientists contributing to agricultural technology and food production technology in general. Supported by the curiosity motive, fundamental ideas upon which technological development feeds will continue to be forthcoming.

Historically, technological development in food production has been supported by war and defense goals to a high degree. Increasingly, technological development is supported by commercial firms using product or service development as a competitive tool. As national trade barriers fall and efficiency of communication increases, the tempo of technological competition increases. Highly competitive agricultural firms find it necessary to acquire increasing portions of their incomes from new technologies.

Educational institutions are expanding services and

developing more effective pedagogical and research technologies. An increasing flow of ideas for technological development in many fields seems to be forthcoming. Agricultural technologies will be transformed, and to some extent circumvented.

In spite of assurances of an adequate flow of goods and services, uncertainties remain. War, pestilence, drought and increasing populations may still render the world's resources inadequate for at least short periods of time. Out of these possibilities a contingency reserve goal arises which supports discovery and development of more productive technologies.

Policy experts need to alter institutions in order to accommodate surplus capacity to produce. Limiting technological discovery and development would inhibit progress toward important personal and societal goals, such as education, defense, contingency reserve and economic development. Prospects for greater control over technological evolution at the points of development and/or adaptation will be discussed in the next chapter.

TECHNOLOGIES AS DIFFERENTIAL FACTORS AFFECTING AGRICULTURAL DEVELOPMENT AND SUPPLY REGULATION

A Case From an Underdeveloped Economy

The preceding case studies point to a wide diversity of motives and goals generating and supporting technological development. Technologies, once developed, also have a wide diversity of impacts upon agriculture. The object of this chapter is to point expressly to the important concept of technologies as differential factors affecting the two basic resources, land and labor, and therefore factors affecting agricultural development and supply of agricultural products. Technologies exert their manifold forces principally through the three basic relationships involved in agricultural production--factor-product, factor-factor and product-product.

A hypothetical case study will provide the framework for demonstrating the diversity of impact possible in the case of adaptation of machinery to agricultural production. The first case study will involve a relatively primitive economy in which central planners desire to increase agricultural output from a fixed land supply, without replacing labor and without increasing the labor supply. Under the present system of production the real marginal return to labor is near zero; that is, output cannot be increased significantly by increasing man-hours of labor under present structures.

Under these circumstances plant breeders from advanced

economies can frequently assist in bringing about increases in production by improving the basic plant stock. Agricultural engineers possessing some background in the old "baling wire" technologies developed in some western countries might be able to assist such a country in increasing output by improving work technique and effectiveness of existing tools. Agronomists might be able to assist in improving job sequence and timing. These technologies all lie at the basis of agricultural development. But in the following case study, mechanization and accompanying technologies form the main framework.

The assumption will need to be made that some source of capital is available at reasonable interest rates, perhaps a public source. Perhaps a combination of western nations will supply the modest equipment needed for the early stages of output improvement.

Cereal production will be assumed as the basic crop activity. In many cases plants producing seeds high in protein could be grown using the same machine technologies as basic cereals. Irrigated rice production will be excluded by assumption.

Since the working force will remain constant, the tool or machine technology will be applied with the expectation of releasing some labor to apply production increasing technologies. Mechanization may have two functions. It may make possible the use production increasing techniques which would not be usable apart from machines. Secondly, machinery may

replace labor. Machinery may function in either manner. From the time at which oil tractors replaced horses in the United States, further mechanization has primarily replaced labor.

In the case being considered the objective is to replace only a small amount of labor which will subsequently be used in applying production increasing technologies which are not a part of the existing production function. In this first stage mechanization of tillage might possibly result in slightly increased output due to better seed beds, but this might be minimal.

It will be assumed that triple purpose beasts are used as draft animals. All equipment will be powered either by these animals or by man-power. The basic improvement in tillage machinery will be provided by an efficient plow and a harrow. The moldboard must be shaped to perform efficiently at the slow speed of draft animals and in the type of soil predominating. The share must be hard-surfaced at the cutting edges, for it is doubtful if blacksmiths would be available for frequent sharpening of shares. A good, efficient plow would release some labor for other tasks, and might contribute to improved seed beds. The spike-toothed harrow might provide an increase in quality of seed bed over existing equipment, and it should release a small amount of labor for output increasing technologies.

It will be assumed that maximum use was being made of available organic fertilizers. Inorganic fertilizers will now

be applied by means of hand broadcast. Seed will be broadcast by hand as before. Fertilizer might be applied in the furrow at plowing time. Cultivation of rowed crops will be accomplished by introducing a modern hoe, the best that modern technology can create. The hoe will be accompanied by a file for sharpening.

If insects are a significant problem, a simple spraying machine will be needed. A simple pump-agitator and a tank mounted on a cart would suffice. This could be a community project. Some chap with a mechanical aptitude could readily be trained to operate and maintain the pump, while another could be trained in the techniques of application to crops. The machine could be either a two or three man unit.

Herbicides would probably not be needed, because most weeds could be controlled by tillage or cultivation techniques.

Improvement of harvesting and threshing equipment and techniques would be required only in the case of significant waste and spoilage. Rodent control and grain fumigation might be introduced. Traditionally, threshing has required relatively more labor than other agricultural practices, but it has been done through winter seasons when there was little else to be done. The mechanical thresher would release large quantities of labor for other purposes. If there were no alternative employment opportunities, this would be a needless capital expenditure. Reaping and threshing machines would not increase output unless the existing system results in

waste and spoilage. In this case the existing techniques might be improved to prevent waste and spoilage without introducing reapers and threshing machines.

An optional piece of equipment would be a hand operated seed and fertilizer broadcaster. This would replace only a little labor, but it would result in a more accurate distribution of seeds and fertilizers in many cases.

Small grain drills with fertilizer attachments might provide a profitable capital investment as agricultural development progresses. This would allow accurate placement of seed and fertilizer, and would not need to replace labor. This would not provide an appropriate investment at the beginning of the development program, however, if capital were severely rationed.

In summary, the modern plowshare and moldboard, the modern harrow, and the modern hoe would be introduced for tillage operations to make possible a superior seed bed and to release some labor for other production increasing practices. A hand operated seed and fertilizer broadcaster would be optional, but might increase accuracy of seed and fertilizer distribution. The sprayer, if needed, would best be handled as a community project. A modern scythe might be introduced for reaping, but this would be optional, depending upon waste arising out of the existing system. Grain parasites would be controlled and spoilage would be eliminated.

As nonagricultural industry develops, and as labor begins

to leave agriculture, machines will have to be introduced which substitute for labor. The triple purpose animals might continue to furnish power, or not, depending on the availability of sources of cheap forage which could not be converted to use apart from ruminants. If these animals were not used for draft they might be upgraded and specialized, or eliminated. If not used for draft more food would be available for human consumption than before. It might be possible to replace the need for animal source proteinaceous material by producing a high quality plant source of protein and supplementing it with small quantities of certain vitamins and amino acids. This would release still more food for human consumption, unless crude forage materials would go to waste if not converted to food by livestock.

Animals could be replaced in draft functions by one-cylinder, two-wheeled tractors. The engine could be of the most advanced design such as currently used in some applications by the U.S. Army; that is, the engine would maintain its rated power output on a wide variety of fuels. Wherein farms were small, the tractor project might become a small community project. Since it would be difficult to train each farmer in the proper use of such a tractor, and whereas a few carefully selected individuals could be trained without difficulty in operation and maintenance, the small tractor pool concept might work relatively better than exclusively private ownership of tractors. Wherein farms were large enough to justify

a tractor the pool would not be appropriate.

The new power source would make possible the adaptation of machines which would reduce labor requirements. Perhaps only small amounts of labor would be replaced in tillage operations, but in reaping and threshing operations relatively large quantities of labor would be released. The small tractor could power virtually any kind of agricultural machine, so that completely modern technologies could be applied if desired. Subsequent mechanization would primarily substitute for labor.

This plan assumes a considerable amount of central planning. However, mechanization might proceed more smoothly than it has historically in western nations. As pointed out in the previous chapter, rapid mechanization has been generated in the United States by three wars.

In summary, the replacement of the draft animal by the small, rugged, efficient and relatively powerful two-wheeled tractor and related machinery would begin to replace relatively large amounts of labor, so is appropriate as industrialization proceeds. Yet the size restriction imposed by the two-wheeled tractor provides a ceiling beyond which further labor would not be released in large quantities. But from this point on up the scale, production potential per unit of land would not be significantly increased by further mechanization. The primary impact would be the replacement of labor.

A Case From a Mature Economy

If the United States is representative of a mature economy, then it may be concluded that, in a mature economy, production capacity exceeds demand for agricultural commodities during periods between great wars. During the last major war, World War II, the entire agricultural capacity was utilized, and since the end of the war farm operators have faced a demand at the firm level quite similar to war-time demand.

When a farm firm faces an unlimited demand for production, from unrestricted acres, at reasonably satisfactory commodity prices, technologies are demanded which maximize income from the given acreage and agricultural labor. Additional capital expenditures substitute for additional land and labor in increasing output rather than for existing family labor and presently controlled land. In the underdeveloped economy discussed above the demand was of this type. But this type of demand might not be continued indefinitely. In two of the three suggested agricultural regulatory features discussed later both aggregate output and output at the firm level would be fixed in a given year. In effect a farmer would be allotted a maximum gross income in any given year, or under certain conditions he would be allowed to purchase rights to various sizes of gross incomes. His new goal would be that of keeping as much of this fixed gross income for himself as possible. From the standpoint of economic theory this is merely another income maximizing problem with an added

restraint, but from the standpoint of selecting technologies for maximizing incomes in the two different situations, the problems can be very different.

When product quantity from unrestricted acres may increase to infinity, from the institutional standpoint, the farmer may substitute capital expenditures for his own labor, for example, according to any whim as long as returns from additional output at least cover the cost of the additional capital, provided capital isn't rationed to the firm and provided productivity of other resources is not reduced. But when the same operator faces a fixed gross income from a given marketing allotment, he will reconsider before replacing his own and family labor and his land with primarily production increasing capital expenditures.

The point to be emphasized here is that somewhat different types of technologies are called for during times when excess agricultural capacity looms large, and in situations in which alternative employment opportunities for certain types of labor are severely restricted, than are called for during times when demand from unrestricted acres is unlimited, at reasonable prices.

Some technologies developed by experiment stations are readily adaptable to either type of demand situation, but additional research in resource combination will probably be necessary. An example of a technology which is readily adaptable to any type of demand situation is found in wheat

production technology. Fort Hays Branch Experiment Station, Kansas, has researched cost minimizing dryland farming technologies for 41 years (31). Table 2 shows some typical results from this research.

Table 2. Average annual wheat production with five fallow and wheat cropping systems, 1918-58 (31, p. 13)

Cropping system	Average annual prod.
Wheat, continuous	14.7
Fallow-wheat	11.7
Fallow-wheat-wheat	14.0
Fallow-wheat-wheat-wheat	15.0

The table points out that a slightly higher average annual production was forthcoming from fallow-wheat-wheat-wheat than from continuous wheat. Income in this very simple case would be increased by applying less capital. During the year of fallow, capital expenditures for seed, fuel, machine services, etc. would be saved, except for small expenditures for keeping weeds down. The 1962 report indicated that, although the continuous wheat plan averaged three bushels higher average yield over the 41-year period than fallow-wheat, the margin of profit, if any, for the continuous system over fallow-wheat was small because costs of production were nearly doubled in the

continuous wheat plan over the costs of the fallow-wheat plan (31, p. 13). Income from the fallow-wheat plan was more stable than from continuous wheat. During the 41 years, less than five bushels per acre were produced 27 per cent of the time under continuous cropping and only 12 per cent of the time under fallow-wheat (31, p. 13).

The marginal return to labor in the fourth year of continuous wheat would be negative, and in one year out of four in the fallow-wheat-wheat-wheat plan the marginal return to labor would be small, according to the report. The fallow-wheat plan utilizes more land than the other plans and yields a smaller quantity of product. But the savings in capital expenditures might make it very attractive under conditions of limited marketing rights.

The studies indicated that income from wheat can be improved over any fixed plan by following a flexible system based on soil moisture at planting time, but the fixed sequence sufficiently illustrated the cost reducing principle being set forth here.

Work simplification patterns resulting in more effective utilization of existing equipment and labor provides another example of technologies suitable for producing a fixed output of product. Agricultural engineers have researched these possibilities from the time experiment stations were established, but the present emphasis might not be sufficient.

Minimum tillage practices provide an example closely

related to the first example above. The Fort Hays Experiment Station has carried on these experiments for over 40 years. These findings would undoubtedly be more closely studied by farmers in the event of marketing restraints.

It would be difficult to discern without a considerable amount of research which technical research results could be adapted by economists in computing optimum production functions for varying demand situations. Under long-run equilibrium prices for agricultural commodities or fixed quotas, farmers will probably demand technologies which result in a relatively greater return to total land under control and total labor in some cases.

Assuming that technologies are heterogeneous in impact upon production, should experiment stations tailor research in technological development and adaptation to demand including government at the level of the firm or to demand at higher levels of aggregation reflecting consumers' choices? It is apparent that the two types of demand have not been correlated to a high degree for several years. To what degree does station research influence farmers in their selection of technologies and to what degree do farmers influence experiment stations in their selection of research projects? Do farmers demand technologies which replace land as land is institutionally restricted and marketing is not regulated?

It would seem that, since most research on new technologies is long range, allocators of research funds might act

upon the assumption that a relatively greater demand for primarily cost reducing technologies adaptable to agricultural production is inevitable for recurring periods in the future of agricultural development. Present research would not have to be abandoned, but in selecting future research projects, the probable effect of evolving technologies upon land and labor might become a consideration in making selections of projects. It appeared to government economists in 1950, in the estimates that the "fifth plate" would absorb all agricultural product reserves, that output increasing technologies were urgently needed. Now it appears that the nation would profit by mixing more land into the production function due to estimates of unneeded crop land by 1980 of 50 million or more acres. It would therefore seem appropriate to conduct research on a long range basis specifically adaptable to each of two recurring demand outlook situations. It would also seem appropriate to reexamine experiment station data with the objective of determining the extent to which present and developing technologies may be used in integrating the structure of technological development and adaptation with the structure of market demand for agricultural products.

RESOURCE USE MALADJUSTMENTS ARISING OUT OF
INCOME SUPPORTING SCHEMES

The substitution of nonfarm produced factors of production for traditionally used agricultural production factors has long been proposed as a solution to the income problem of individual farmers, and it has been a satisfactory solution for some farmers. But this substitution has historically resulted in more intensive use of a given unit of land and in aggregate production beyond that which could be absorbed by markets at satisfactory prices. During the 1920's John D. Black suggested that in many relatively unproductive farming areas, extensification was a superior solution to the individual farmer income problem than intensification (4). He further suggested that Congress provide for special types of credit designed for aggregating units of land and adapted to the particular income flows and risks involved in such enterprises. Black pointed out that one of the principal opportunities for service to agriculture which the federal land bank system afforded was making loans in inefficient agricultural areas for purposes of aggregating small tracts of land into larger tracts and encouraging extensive types of production. At that time there was not sufficient desire to design farm legislation to implement complex policies suggested by visionary agricultural leaders. The early land bank loan limit of \$10,000 did not allow for aggregating farming units on a significant scale;

and the mortgage limit of 50 per cent of the appraised value of a farm plus 20 per cent of the value of fixed improvements was not conducive to farm enlargement and extensification.

In 1944, Dr. Black, while commenting on the tendency of agricultural professors and congressmen to encourage efforts toward income improvements to farmers through intensification of management, made the following statement (5, p. 143):

Those who propose making small farms more productive need to consider still another aspect of the matter. Efficient intensive management of a 60-acre farm in southern Wisconsin, or in the Champlain Valley of Vermont, will yield as good a return as rough and ready extensive management of twice that acreage. The 60-acre farm will operate at a considerably higher fertility level than the 120-acre farm--it will have more operating capital invested currently per acre. If all dairy farms shifted to this intensive system, however, the market for dairy products would be glutted The consequence of this is that some farmers operate at one level of intensity and some at another, and the balance between them keeps the supply of milk at a level that equates with demand at prices that keep a certain quota of workers on the land But it is not possible, even where the farming lends itself to such intensification, to apply it to all the farms until the demand for farm products increases markedly.

Dr. Black went on to point out that the income of farms in general in a particular region could not be increased by intensifying all the farming in the region due to the "surplus" condition which he predicted would occur in this country in 1948 and after. There seems to be an implicit assumption in Dr. Black's writings that land is reasonably free to compete with its substitutes, or the type of equilibrium which he describes would not be possible. At the time Dr. Black wrote, the effects of land use restrictions coupled with pegged

prices for agricultural commodities were not foreseen. In fact he had no way of knowing that such a policy would be continued far into the future.

Dr. Black assumed that as a market glut appeared, prices of the commodity would fall to a point at which further intensification in a region would be forestalled. The application of further intensifying inputs would no longer be profitable. At this point most of the farmers who had already made intensifying investments of a substantial nature would maintain a given level of intensity due to the necessity of recovering as much of the fixed investments as possible, but other farmers would not find intensification profitable. A few farmers who had intensified on an unprofitable financial basis would fail and either become farm laborers, tenants or move into other work. Some approximation of an equilibrium situation would likely occur.

However, when the price is held at a level above an equilibrium level, intensification goes past the point at which it would be set by equilibrium conditions. Also, as land is removed from use in a community, a further stimulus toward intensification occurs as labor and management, working fewer acres, become underemployed. Entrepreneurs will frequently purchase neighboring land at a price which indicates little expectation of a net return from the land so that surplus labor and capital equipment may be more fully employed. As returns from land have in certain instances been virtually

guaranteed by program agreements augmented by inflationary tendencies within the economy, investors from outside agriculture have purchased agricultural land, thus increasing competition for land further.

As intensification of agricultural production has failed in many farming areas to yield desired incomes due to the nature of the demand for agricultural products and the increased production per unit of land over so great a proportion of tillable land, a second means of supporting income to agricultural workers has been attempted. A brief account of the struggle underlying the legal synthesis of regulatory programs appears in the last chapter of this dissertation. The main thrust of the programs has been the regulation of land use and in effect the limitation of land use. Impact of regulation has varied from permitting competitive crops to be grown on restricted land all the way to permitting no use to be made of the restricted land. Most income assists have accrued through pegged prices for commodities. Some direct payments have been made for retiring land. Whichever way land was restricted the result was about the same as long as farmers could sell all they could grow on unrestricted land and market it at pegged prices. The land resource was not allowed to compete on the same basis as other resources.

Walter E. Chryst and John F. Timmons discussed this problem of substitution among the factors of production in a recent publication (15). For several decades, they pointed

out, capital and the resources which go into the development of technical innovations have substituted for land, but the returns to land generated by programs and structures have made the reverse substitution impossible. They emphasized the point that program benefits have been capitalized into land values. This point will be discussed later.

T. W. Schultz suggested that, even as returns to land have increased, income claims to land have become an ever smaller fraction of the national income (83, pp. 125-145). His study was made in 1950, but the principles discussed seem to be valid today. At that time he estimated that in the United States about 12 per cent of the disposable income was expended for farm products that enter into food and that about 20 per cent of the cost of producing farm products was net rent. Thus only about 2.5 per cent of the income of the community was probably spent for food producing services of land in comparison with some high-food-drain countries in which about one-half of the income, at factor cost, was spent for services obtained from agricultural land.

Proceeding further, Schultz arrived at two propositions which he believed to be historically valid in representing the economic development that has characterized western communities: (1) A declining proportion of the aggregate inputs of the community is required to produce (or to acquire) farm products. (2) Of the inputs employed to produce farm products, the proportion represented by land is not an increasing one,

despite the recombination of inputs in farming to use less human effort relative to other inputs, including land. It is this second principle which agricultural programs have been designed to counteract. As factors of production used with land have been made available at prices competitive with land, causing less land to be used in the production function, relative to other factors, institutions have been created which effectively reduce the supply of tillable land. There has been on one hand a tendency for agricultural leaders to encourage intensification, and on the other hand the creation of institutions to take a part of the land released out of the market.

The pressure on farmers to adapt new factors of production would seem to have been unwise apart from the defense goal, the contingency reserve capacity goal, and economic development goal, all previously discussed. The reserve capacity may have been an important factor in our survival, and history may repeat itself in this respect. But it would seem to Chryst and Timmons that land should be permitted to compete with factors which would replace it. They point to the failure of land-use restriction as used in the past to improve agricultural income significantly over what might be expected from reasonably stabilized agricultural markets without price supports considerably higher than equilibrium levels.

There is ample evidence that a significant part of the expected income from high price supports has been capitalized

into land values, and there is no logical reason why this capitalization would not occur. Regression studies of land values in both Kansas and Virginia have shown a very high correlation between the production rights and land values. In both cases the next highest allowable uses for the restricted land resulted in a relatively low return to land (15). It would seem logical that good wheat land on which wheat might be produced would be more valuable than good wheat land on which institutional restrictions prevented the raising of wheat in the presence of high wheat support prices.

A study of the effects of this type of land use restriction and high price supports was conducted in an Ontario, Canada, situation. The interesting tendency which appeared here was the rapidity with which this capitalization process took place. In 1957 the Ontario Flue-Cured Tobacco Grower's Marketing Board was formed with the power to regulate production and marketing of tobacco. A board fixed allotments to individual producers, and a new law required all growers to obtain a license to sell their tobacco and market it through auction warehouses operated by the Marketing Board. This system resulted in the removal of a considerable amount of uncertainty from the production and marketing process. The farmer was assured that with marketing rights he would be able to sell his tobacco under the rules established by the Marketing Board. The grower could expect to receive at least the minimum grade price for all tobacco sold.

A study of the effects of this program on land values was conducted by the Department of Agricultural Economics, Ontario Agricultural College, Guelph, Canada (29). During the period of the study, the income of tobacco producers rose quite sharply, but fixed assets received more than the increase in income, proportionally. The evidence of the capitalization of income into land values was found by a study of 17 tobacco farms that had been sold more than three times in the 1948-59 period. The market value of these farms increased at the average rate of \$4500 per farm per year, which resulted in more than doubling of farm values during this period. The credit used to purchase these farms was mostly from private sources, usually the former owner. From 10 to 20 per cent of the price of the farm was customarily required as a down payment. The mortgage was commonly amortized according to a quarter crop payment clause, under which the buyer contracted to pay annually one-quarter of the gross receipts from the tobacco as principal and interest. This forced the buyer to accumulate assets at a rapid rate, thus seriously reducing his standard of living while paying for the farm.

The study reached the conclusion that, in general, any program designed to raise the income of producers tends to be self-defeating in the long-run, because the higher incomes tend to be capitalized into higher land values and thus raise the cost structure, unless some arrangement is developed to prevent the tendency.

Increasing income to farm operators principally through land ownership would work well if all farm operators owned the land they farmed and if they all lived forever. Even when there is only one heir, higher land values mean higher estate and inheritance taxes. When there are more heirs to the land, higher land values mean that a greater part of farm income accrues to brothers and sister, often not associated with agriculture, as settlements are made. When land is sold, the vendee pays to the vendor the capitalized value of expected program benefits, or some portion thereof.

The effects of past income support programs upon the incomes of lessees has varied according to the lag of customary leasing arrangements in reflecting the increased value of the land. Cash rent tenants who have paid no more cash rent after high price supports have profited from programs. Those tenants operating under crop share leases have shared a part of the benefit from programs with land owners, even when leasing arrangements have not been changed.

Chryst and Timmons point out that during periods characterized by uncertainty concerning the permanence of support programs, allotments have not been capitalized into land values to a high degree (16, p. 263). For example, the doubling of net farm income during the period 1933 to 1941 was accompanied by an increase in land values of only slightly more than 10 per cent. From 1941-1945 land values still did not rise proportionally with farm income, but after 1946 confidence in

continued supports and a continuing stream of production factors and techniques profitably usable with land became firm and land values more than doubled from 1946 to 1958.

This writer knows of no study or argument which would refute the conclusions of the studies and discussions presented above. The point of disagreement arises as the future course is considered. Should the value of agricultural land be allowed to deflate under low price supports or no price supports, or should land values be maintained as they are recognizing that through investment in land at high values considerable agricultural income will be drained off in the form of interest and payments outside the agricultural sector, but rationalizing that this is a cost which cannot reasonably be avoided?

Chryst and Timmons favor a program which would allow land to become more competitive with other factors of production, as will be pointed out in the following chapter. On the other hand J. Carroll Bottum, agricultural economist at Purdue University, states his view as follows (7, p. 68):

I am discussing a program to maintain present land values. I do not see the desirability, from the long-run standpoint of agriculture, of carrying the program to the point where the gains are bid into land. I do see the value of maintaining land prices, the capital structure of agriculture, and farm incomes once we have reached a given level for a period of time.

When Bottum indicates that he is in favor of maintaining land values, he is referring to a particular quality of land. He would maintain present land values only in the case of

tillable land remaining unrestricted for intensive agricultural uses. In respect to restricted land, as will be pointed out in the next chapter, land owners would presumably be paid the differential between the value of the land which has been established under income support features favorable to land owners, and that value of the land which would be established with the rights to intensive cropping removed.

Other programs would handle this differential by allowing the farmers in the inefficient areas to sell their rights to farmers in efficient areas of production. It is clear that this price differential at the intensive-extensive margins of production is an unprecedented obstacle to changes in land use.

attempted to follow most of the time since 1929, although there has been some dissatisfaction with the fact that programs have been of value to farmers about in proportion to scale of production.

Under the market system, if an industry or a firm finds itself in a poor bargaining position, it improves its position or liquidates. Under the Schickele philosophy the public seeks to maintain the income position of firms within agriculture, generally. This makes it necessary for the public to improve the weak industry's bargaining position. There is a more flexible and workable interpretation of egalitarian principles of income distribution, however. Under this interpretation the public would assist individuals in obtaining an income commensurate with their talents if possible, but not necessarily in one particular occupation. This more flexible interpretation need not work great hardship upon younger citizens forced to accept jobs of second or third choice, since in our society the margin of desirability between or among several occupations an individual might pursue could be quite small. It has often been observed, however, that as farmers become older, the margin between the desirability of farming and other jobs that they might possibly do becomes greater. It is for this reason that some members of the economics profession have placed emphasis upon the need for constantly upgrading the quality of human resources remaining in agriculture, and upon creating institutions for purposes of

upgrading nonagriculture skills. The Chryst-Timmons program contains suggestions for these functions.

The observance of egalitarian principles of income distribution need not distort resource allocation patterns based upon efficiency if the equitable income stipulation is not tied to one particular occupation. This is an area of great challenge as an increasing rate of change is brought about by an increasing flow of new factors and technology.

The suggested programs for guiding resource use adjustments do not promise to raise present income to agricultural laborers significantly, and they offer no panacea for solving adjustment problems without movement of resources among possible uses. Only three program variations will be discussed here. Some features of these programs promise to impart needed flexibility or mobility of resource use, both intra-agriculture and interindustry. There is a cost in each case, a cost attached to past rigidities and mistakes. This is the cost of handling the differential between what the commodity markets would indicate land is worth, even in a stabilized market, and what land sells for under high price supports. In discussing these programs, or program features, the following criteria will be followed in general:

- (1) Is the public institutional structure required by the program readily adjustable and flexible?
- (2) Is the private institutional structure arising out of the program responsive to changes in market demand for commodities?

- (3) Would resource use rigidities arise out of unrealistic psychoeconomic expectations?
- (4) Could the entire public program be abandoned without causing unreasonable hardship in terms of frustrated income expectations?
- (5) To what degree is technology likely to make it possible for farm operators to circumvent the desired impact of the regulations.
- (6) To what degree is technology likely to make the features obsolete?
- (7) Are there likely to be constitutional problems?
- (8) What are expected technical problems of program operation?

The last two questions will be discussed in the last chapter.

Privately Saleable Marketing Rights

This plan was suggested by Willard Cochrane in 1957 (18). The plan calls first of all for the legal separation of the rights to market certain commodities from the residual rights inherent in the fee ownership of land. These rights to market certain quantities of commodities would be made negotiable. The initial marketing base would not change significantly from that of present programs, except that the right would be expressed in terms of units of commodities rather than in land-use allotments. The plan could conceivably be applied to only one commodity, or separately to more than one commodity, but Cochrane has suggested that the plan be applied comprehensively to all agricultural commodities, including livestock.

In a subsequent article, Cochrane pointed out some difficulties which would be encountered in attempting to support returns from feed grain grown as a cash crop while supporting livestock returns (19). The problems involved in this vertical integration of support programs within one complete phase of the agricultural industry were not solved conceptually and probably could not be solved without empirical testing.

Marketing rights would be free to move throughout the United States, under the plan. This mobility of resources should contribute to efficiency of resource use, but it is doubtful if Congress would allow unrestricted negotiability, geographically. Cochrane stated that the negotiability feature would accomplish the impossible "(N)egotiability permits production flexibility at the local level within a controlled aggregate" (19).

Adjustment of supply would be achieved by shrinking and expanding by law the quantity of commodities represented by the marketing right instrument (certificate). If this program were adopted, Congress would surely be asked to limit the rate of transfer of marketing rights from one community to another, just as Congress has been asked to limit the amount of land retired in each community through the Conservation Reserve program. But anything less than complete restriction of movement of rights would still allow greater efficiency of resource allocation than present programs. Local farmers would have the choice of holding and using marketing rights

or selling them. These people, in an unrestricted system, would hold the fate of communities in their hands. In some areas the motivation to sell would be strong.

Some farm income would flow into certificates and into interest on the investment used to maintain the certificates. From the macro viewpoint it is difficult to imagine the reservoir of capital investment in certificates as productive capital. It is no more productive capital than the increment of land values attributable to agricultural programs. From the viewpoint of the individual farmer the certificate is a capital item necessary for doing business. Cochrane recognizes the certificate as the "cost of doing business in a stabilized economy" (19). From the viewpoint of consumers the certificate would represent a rationing expense which would be met through increased commodity costs.

The possible gains of this program over present programs are more precise control of aggregate supply, and the possibility for a more efficient allocation of production of agricultural commodities. The cost of this rationing device is mentioned above as a demerit. A second demerit arises as one considers how this program would be eliminated. It would be unusual indeed if a new technology did not date the program, as it surely will date virtually any public program to direct resource use. Probably the most simple, but most costly, method would be that of government reimbursement of certificate holders. It is not conceivable that any Congress would wipe

out these certificates without some form of reimbursement. This would be more harsh than wiping out specific production rights attached to land, because in the latter case there is some residual value left in most cases. It would be difficult to pass into an unregulated market situation from the negotiable marketing right program. The most logical course would be to pass back into the system of allotments or marketing rights attached to land for a time. This technique is discussed in the next chapter along with some other technical problems. But the fact remains that the difficulty of moving from one type of a program to another would be greater than in the case of the situation we are presently in. It would seem, however, that this program would perform its advantageous functions through more waves of technological advance than the program we have been using since 1938. Production should continue to concentrate indefinitely in areas with comparative production advantages.

Farmers have worked under high motivation under past programs to increase aggregate supply far beyond quantities which could be absorbed by traditional institutions. The negotiable marketing right plan would avoid a large part of this pressure to increase supply, but since the certificates would be contractable and expandable, presumably through administrative procedure authorized by Congress, there would be considerable political pressure to expand the quantity which each certificate represented, in order that certificate holders

might receive a windfall gain. If certificates were fixed, expansion of demand due to population increases or the opening of short term markets could be accomplished by selling certificates good for only one year, according to the Timmons-Chryst proposals. This should reduce the political pressure arising out of attempts to induce expansion of certificates. It would also prevent as great speculation in certificates as would otherwise occur during periods of temporary increases in demand for commodities. There would be less institutionalized opposition to eliminate the program if a significant part of the certificates were of a temporary nature.

Agency Sale of Short Term Marketing Rights

Walter Chryst and John Timmons have proposed a plan for government agency sale of short term marketing rights (15). Marketing rights would be severed from fee simple property rights as in the previous program, but in this case rights would revert to a government agency rather than becoming negotiable. Each year the agency would determine aggregate needs for commodities and support prices for commodities, then accept bids from farmers for marketing rights for the subsequent year's marketings. Rights would be neither durable nor negotiable, but would apply only to the marketing of one year's commodity.

The authors of the program believe that the amount spent for marketing rights would approximate the amount presently

being spent for marketing rights attached to land in the form of payments on land purchase contracts, mortgages and interest on such indebtedness. Since marketing rights would be good for only one year, there would be no capitalization problem. Borrowing to pay for rights could be eliminated by deferring payment until crops were sold. This system would result in a rather basic alteration of the farm mortgage credit system and the local property tax base. The resulting pattern of property evaluation might not vary greatly from that which would result from a period of unregulated production and unsupported prices. The authors imply that this program is particularly well suited to those cases in which the differential between probable market equilibrium prices and present prices is rather large, such as in the cases of wheat, tobacco, and perhaps cotton.

The present public institutional structure would probably be sufficient for carrying out the agency sale program with minor alterations. The burden of land measuring and inspection and enforcement of acreage allotments would be eliminated, as in the case of the negotiable rights program. Market firms would be required to cooperate in the enforcement of marketing restrictions and rights. These businesses would be required to keep adequate records of marketings in relation to certificates, and the records would be subject to audit by agency personnel.

Eliminating this program would not be difficult since there would be no long-term financial commitments made on the

basis of expectations of income arising out of the program. In fact this program would facilitate a return to an equilibrium price for all factors of production, and this was the principle rationale underlying its creation (15, p. 274):

The use of the funds for this purpose would continue until the number of people who had transferred was sufficient to make the earnings of farm people comparable to those of their urban counterparts. At this point the program would be abandoned.

The proceeds for the sale of marketing rights would be used for directing the adjustment in resource use in the following ways (15, p. 273):

(1) grants and loans to cover moving expenses of farm people to nonfarm employment; (2) unemployment compensation, as needed, for those who move for the first two years or so after leaving farming; (3) development of an extensive system of vocational training in rural high schools to prepare youth for nonagricultural occupations; (4) establishing a program of college scholarships for the more talented young people; (5) where economically feasible, assisting in the establishment of industries and other nonfarm businesses in rural areas.

D. Gale Johnson refers to the type of assistance described above as "minimizing the difference in earnings required to achieve a given rate of migration" (49). But Chryst and Timmons have suggested a source of funds for carrying out the adjustment, a source which they believe to be presently inhibiting rather than contributing to adjustment in resource allocation.

Since the initial loss of marketing rights would work a hardship upon farmers owning their land, especially those owning small equity in farms purchased under expectations of

continuing programs weighted in favor of land owners, the authors suggested that the program might be worked into gradually. At first marketing rights might merely be made personal to individual land owners. Legal implications of this procedure are discussed in the following chapter. Initially, basic acreage allotments might be cut substantially, thus allowing the agency to acquire adjustment funds immediately by the sale of marketing rights, the authors asserted.

The means by which these rights would be sold could substantially alter the impact of the program upon traditional property rights. The authors suggested that marketing rights be sold by bid, but did not spell out technical details. The sealed bid method by which government agencies sell used for surplus equipment could be ruled out in this case because of inequities which would arise out of such a system. At least one logical method for selling marketing rights by bid is presented below.

Bid sheets for each commodity would be issued by the selling agency. Sheets would report the price at which the commodity would be supported for the relevant crop year. Sheets would display a series of prices per unit of commodity marketing right, probably bushels or pounds, which would be bid by the purchaser. The farmer would insert at each of the several prices the quantity of production rights he would desire at that price. An example appears in Table 3.

Table 3. Marketing Quota Bid Sheet

Support Price \$1.80/bu.

Mkt. Right Price/bushel	Quantity of Marketing Rights Desired (bu.)
\$.80	<u>none</u>
.70	<u>300</u>
.60	<u>600</u>
.50	<u>1000</u>
.40	<u>1000</u>

Name _____

This bidding process would make it possible for all farmers within allotted areas to participate in production, or not, according to their own estimation of the profitability at various levels of marketing right cost. The allocation of rights would be determined by adding horizontally across all bid sheets within an allotted area. The sum of production commitments at each price would be obtained. This would give the aggregate production of a commodity arising out of each marketing right price. The row adding to an aggregate production commitment approximating the fundamental area allotment would become the accepted bid. Every farmer within a given allotment area would pay the same price for the marketing rights per unit. At the beginning of this program the fundamental allotment area might be one county, such as at present. Adjustment would be progressively speeded by including several

counties within an allotment area, then a state, a region, and eventually the entire nation. Bid sheets would then be added horizontally across the entire nation. The production shifts under this method of handling bids could not be classed as allocation of production by law, for the rights would be allocated on the basis of voluntary bids by farmers. The resulting allocation of production would probably be similar to that which would result from an unregulated market allocation. Congress would merely be releasing forces of comparative advantage by degrees rather than in one step. This would tend to reduce the shock of released market forces. A system of bidding such as this should prove to be both fair and workable. The price per unit paid for marketing rights would be uniform throughout one allotment area.

To the extent that allotment areas would be increased in size, allocation would approach a national efficiency pattern. Resources would tend to move more freely between agricultural uses and interindustry. But the initial step taken to reduce the impact of the program upon property rights (making marketing rights personal to individual farmers) would tend to reduce mobility of labor resources out of agriculture, and would not result in speeding changes in land use. If a farmer were placed in a position in which he could recoup his investment in land only by continuing to work the land he would be motivated to remain on the land and use it as intensively as possible. However, this might be a just way of bringing about

a shrinking of the structure of agricultural land values, if this policy were to be adopted.

The alteration of rural educational institutions to provide means whereby farm youth may acquire training in non-farm sciences and technologies is a necessary supplement to any effective program for agricultural resource adjustment. It would seem that the communities needing these facilities would be the least able to support them from locally available funds, though there would be exceptions to this principle. It would also seem probable that relatively affluent allotment areas would pay more for marketing rights, thus contributing the greater proportion of the funds for adjustment.

The availability of funds from this source would reduce one obstacle to needed changes in available rural education. But other obstacles would remain in the way. It might be discovered that the majority of the administrators of the vocational agricultural programs, for example, are satisfied with rural vocational training as it is. It would be unusual if there were no entrenched obstacles to the basic alteration of rural educational systems. Systems which have served well during certain periods of the past are sometimes changed with regret. A concentrated effort to upgrade human resources in the process of bringing about shifts in human resource use would contribute to more valuable and more effective adjustments.

The consumers would pay for this program of adjustment in

the form of prices higher than would result through unsupported market prices (45). A program of institutional innovation sponsored through federal taxation would result in a somewhat different allocation of cost burden.

Easements versus Contracts

The use of the easement to control crop production in certain instances is usually considered in the same category as the use of land use contracts between a federal government agency and the individual farmer. However, in effect upon expectations there is a fundamental difference which should be reemphasized. Most conservation reserve contracts were of five years or less in duration, while a few were of ten years duration. Considering the type of land which was retired through the use of these contracts, it seems probable that most of it will remain in extensive uses after the expiration of the contracts, but as this method of shifting land use is being used and considered for wider use in retiring the better quality land, the differences between the regulative value of these contracts and that of the easement needs to be reviewed.

The contract could be nullified by either party to it in the case of conservation reserve contracts. The government could release the land for intensive production at any time if that action was considered to be in the public interest. The land owner could nullify the contract by violating its provisions, such as allowing livestock to graze the land.

The only penalty against such action was the requirement of repayment of money received for assistance in establishing a cover. More severe penalties could be required of violators, however, making it uneconomical to violate the contract. But in the case of better crop lands, owners entertain expectations of use of the land for intensive crops at the expiration of the contract, and herein lies a problem.

Dale E. Hathaway reminds us that any program which maintains prices and improves certainty will tend to encourage individual farmers to increase output (45). As long as the program is voluntary, significantly higher prices will lower participation and tend to be self defeating. If short term contracts were used on a scale large enough to increase prices, or if prices were otherwise increased or costs reduced, subsequent rounds of contracts would cost more than the first, under voluntary contracting. John A. Schnittker, U.S.D.A., has suggested purchase of long-term crop production rights by means of lump-sum payment at the beginning of the contract period (82). The cost of this type of contract might not be very different from the cost of an easement to perpetuity. The easement would offer a greater measure of flexibility than the contract for these long-term uses. The technical aspects of this problem are discussed in more detail in the following chapter. The easement could be leased to the owner of the burdened land for a sum or merely for a consideration, depending upon the need for shifting income between sectors. The

contract always expires at some time. The time of expiration could very well be a period in which the release of large quantities of land could cause grave problems for the economy. Following the reasoning presented in the first chapter, it would appear that land will face an increasing array of substitutes in the future. If voluntary land retirement were to be seriously considered as a permanent program, the easement would appear to be the logical choice as the restricting instrument. It would immerse the Government more deeply into property institutions, but this should not result in serious problems.

The easement would result in a different set of expectations of future use of the restricted land, and thus affect the price at which the land would sell on the market. If a rigorous program of land retirement were successful in bringing about substantial price increases, the land restricted by contract would tend to sell for an increasingly higher price as the contract expiration date was approached. This tendency is one which must be avoided if gross maladjustments in resource allocation and income distribution are to be avoided.

The easement would seem to be a nearly ideal instrument for maintaining a reservoir of productive capacity at minimum public expense. This capacity would need to be maintained only in uses which would permit immediate return to intensive cultivation. There would appear to be fewer problems of

administration of the restricted lands than in the case of government ownership. This function might become appropriate completely apart from any attempt to support prices for agricultural products. The effect of large-scale withdrawals of land from intensive uses would probably have some effect on prices of agricultural commodities, but might not be great if only enough were taken out for contingency reserves. This land reservoir would not present spoilage problems, as would commodities. Quantities of stored commodities could be considerably reduced.

John F. Timmons¹ has long advocated the easement as a possible instrument for bringing about land use adjustments and maintaining land reserves. He has pointed out not only the contingency reserve possibility, but the possibility for bringing about patterns in land use through selective purchase of cropping rights according to any desired pattern.

¹Timmons, John F. Department of Economics and Sociology, Iowa State University of Science and Technology. Easements for regulating supply. Private communication. 1959.

APPRAISAL OF THE ADEQUACY OF EXISTING LEGAL CONCEPTS
AS A FRAMEWORK FOR IMPLEMENTING SUGGESTED PROGRAMS

The programs discussed previously or other possible programs will probably not be seriously considered and studied by the economists if there is doubt about their legal validity under court scrutiny. New laws creating new relationships between people and between individuals and Government usually stimulate fears and doubts based upon legal questions. In this chapter most of the programs which have been used in the past in agricultural regulation and those programs which have been proposed for such regulation will be discussed from the legal viewpoint. Since past federal regulatory programs have failed in some respects to bring about a desired pattern of income distribution and resource allocation, it seems probable that some suggested regulatory techniques will create new legal relationships between farm operators and Government, and between and among farm operators. These new relationships necessitate reexamination of Constitutional law and common law. Most of our present regulatory legislation is based upon previous legislation which was at one time or another declared unconstitutional. Constitutionality is a dynamic concept, and since economists are concerned with models of regulatory schemes which would be enacted into law only in the future, not in the immediate present or the past, it would seem to be profitable for researchers to guard against excluding program

features from consideration on the basis of doubts about their validity under either Constitutional law or common law.

Constitutional questions seem to have a peculiar appeal for a great segment of the American public. While such an interest would seem to be associated with good citizenship, problems arise out of this interest due to the failure of many to discern the difference between problems of constitutionality and problems of policy. Mr. Felix Frankfurter, retired Justice of the United States Supreme Court, made the following statement in this regard (38, p. 332):

No matter how often the Court insists that it is not passing on policy when determining constitutionality, the emphasis on constitutionality and its fascination for the American public seriously confound problems of constitutionality with merits of a policy (P)ublic opinion too readily assume(s) that because some measure is found to be constitutional it is wise and right, and contrariwise, because it is found unconstitutional it is intrinsically wrong.

It is not possible to precisely define the difference between problems of constitutionality and problems of policy. It is necessary to follow the thread of some constitutional question from its origin to the present time to really grasp this important differentiation. It will be seen in this chapter that policy is one of several factors taken into account in determining constitutionality, but the latter problem also takes into consideration a general weighing of rights of individuals and groups in conflict within the context of the guiding principles of Constitutional law. Persons who work with policy problems will reply that they too work

within the context of the traditional guiding principles set forth in constitutional law, and seek at all times to be guided by these principles. In general this is true. But the court system is left with the responsibility of defining the law as it is to be applied to the resolution of conflict in specific instances. That this process is not a precise one can be deduced from a statement by Felix Frankfurter (38, p. 234), " constitutional adjudications involve adjustment of vast and incommensurable public interests through episodic instances, upon evidence and information limited by the narrow rules of litigation, shaped and intellectually influenced by the fortuitous choice of particular counsel". It cannot be denied, however, that policy is also shaped within fairly narrow rules of construction, no less powerful because of their informality. And what policy position is not shaped and intellectually influenced by choice of counsel? But the difference between questions of policy and questions of law or constitutionality remains.

What is the function of the United States Supreme Court? Does the Court seek out controversy in order to define and interpret law more thoroughly? It seems paradoxical that the Supreme Court of the United States has often attempted to avoid constitutional controversies. In the case of Ashwander v. T.V.A. (2, p. 346), Mr. Justice Brandeis stated that the Court, by applying its restrictive canons for adjudication, has in the course of its history avoided passing upon a large part

of all the constitutional questions pressed upon it for decision. Mr. Frankfurter sees the Court's function as "submit (ting) large generalizations that illumine or harmoniously assimilate discrete instances" (38, p. 237).

In characterizing present-day law Mr. Frankfurter made the following statement, which is in harmony with the thesis of this dissertation (38, p. 226):

The vast enveloping present-day role of law is not the design of a statesman nor attributable to the influence of some great thinker. It is a reflection of the great technological revolution which brought in its train what a quiet writer in *The Economist* could call "the tornado of economic and social change of the last century". Law has been an essential accompaniment of the shift from "watchdog government"--the phrase is George Kennan's--to the service state. For government has become a service state, whatever the tint of the party in power and whatever time-honored slogans it may use to enforce and promote measures that hardly vindicate the slogans. Profound social changes continue to be in the making, due to movements of industrialization, urbanization, and permeating egalitarian ideas.

The Constitutional subjects of this chapter are carried along on two themes, one of which is of little importance to this thesis. But the themes are inseparable. The first deals with the power of government in general to regulate commercial enterprise and property use. The second deals with the question of which government, in a particular instance, has the authority to do the regulating determined to be appropriate. The Fifth, Tenth and Fourteenth Amendments to the United States Constitution are involved in this progression of law, but by the time this chapter is about two-thirds finished, two of these will have been dropped from the discussion as not being

relevant to agricultural regulation by Congress. Why, then, does it seem necessary to present the first part of the chapter at all? The reason is that the power of Congress to regulate agricultural enterprise and property use cannot be understood apart from at least the small amount of material explaining the development of regulatory concepts. During the discussion of some of the programs, common law is the foremost consideration rather than Constitutional Law. The two sources of law are not unrelated, however.

The Development of the Power of Congress to Regulate Interstate Commerce

To follow the development of the power of Congress to regulate interstate commerce is to follow the technical and economic development of industry in general. It would be futile to attempt to discuss the background of the power of Congress to regulate agriculture apart from other industry, for broad regulatory principles are involved which cannot be analyzed by division of industry. Since one objective of this chapter is to evaluate the power of Congress to regulate future agricultural industry, it seems necessary to review the power as it exists and as it developed. The caotic and rapid development of this branch of law has not completely blotted out observable continuity. Definite trends may be observed, and these trends can be understood in the light of technological and social development.

The Constitutional Convention was called to "take into consideration the trade of the United States; to examine the relative situation and trade of the said states; to consider how far the uniform system in their commercial regulations may be necessary to their common interest and their permanent harmony; and to report to the several states such an act relative to this great object" (32, p. 115). The resolution adopted at the Convention reads as follows (32, p. 117): "Resolved, that the national legislature ought to possess the legislative rights vested in Congress by the confederation; and moreover, to legislate in all cases for the general interests of the Union, and also in those to which the states are separately incompetent, or in which the harmony of the United States may be interrupted by the exercise of individual legislation". The resolution above evolved into the present Section 8 of Article I of the Constitution. It was adopted by the convention without objection or comment, according to Elliot, although there had been considerable debate on the original resolutions. The commerce clause presently reads, "The Congress shall have the power to regulate commerce with foreign nations, and among the several States, and with the Indian tribes". (Article I, Section 8, Part 3 of the United States Constitution).

The commerce clause was adopted at the Constitutional Convention in 1787, but Congress made little use of the power until it passed the Interstate Commerce Act in 1887 and the

Sherman Act in 1890. However, in 1824 the United States Supreme Court was asked to determine the constitutionality of a New York law vitally affecting commerce among the states (41).

Shortly after Robert R. Livingston and his partner, Robert Fulton, developed successful steam-powered boats the New York Legislature extended to them 30-year monopoly powers to navigate New York waters under steam power. Within a few years the granting of such exclusive franchises became a practice which a number of Eastern states found it necessary emulate in retaliation. It appeared for a while that an achievement of science which had seemed destined to enlarge the means of communication and develop the commerce of the nation would rather embroil the states in bitter antagonisms and commercial warfare such as had prevailed during the period of the Confederation (28, p. 315). Against this background the case Gibbons v. Ogden (41) was cast. In this case the right of New York state to grant such a monopoly was challenged. The New York court had upheld the validity of the New York statute establishing the monopoly and had repudiated the idea that there was any conflict involved between federal and state authority. The decision was appealed to the Supreme Court of the United States, thus presenting the first federal case under the commerce clause of the Constitution. Mr. Chief Justice Marshall delivered the opinion of the Court.

Mr. Felix Frankfurter has stated that John Marshall holds the distinction as the only judge who was at the same time, as

a judge, a great statesman. He believes that John Marshall's views have become the presuppositions of our political institutions. The following quotation will serve to illustrate the esteem in which the legal profession holds this man, John Marshall (38, p. 218).

When Marshall came to the Supreme Court, the Constitution was still essentially a virgin document. By a few opinions--a mere handful--he gave institutional direction to the inert ideas of a paper scheme of government. Such an achievement demanded an undimmed vision of the union of states as a nation and the determination of an uncompromising devotion to such insight. Equally indispensable was the power to formulate views expressing this outlook with the persuasiveness of compelling simplicity.

In the opinion of the Court in the case of Gibbons v. Ogden, Mr. Justice Marshall defined the word "among" as intermingled with, and went on to say that, whatever the power of Congress over commerce may be, that power must be exercised within the territorial jurisdiction of the several states (41 in 28, p. 319).

We are now arrived at the inquiry, What is this power? It is the power to regulate; that is, to prescribe the rule by which commerce is to be governed. This power, like all others vested in Congress, is complete in itself, may be exercised to its utmost extent, and acknowledges no limitations other than are prescribed in the Constitution. It may, of consequence, pass the jurisdictional line of New York, and act upon the very waters to which the prohibition now under consideration applies.

The opinion went on to point out that interstate commerce concerns more than one state and that the completely internal commerce of the state may be considered as reserved for the state itself, as far as regulation is concerned. But the

Court was explicit in pointing out that Congress could regulate commerce which affected the states generally. The scope of this definition of the power of Congress to regulate interstate commerce has never been exceeded, but the case did not lay down rigid and clear rules for determining exactly at which point commerce within a state affected states generally. By couching the definition of the power in broad, general terms Mr. Justice Marshall established a precedent which could be as easily followed two centuries after the decision as immediately following. It is obvious today that the precedent established by that decision went far beyond the holding itself. Virtually every part of the opinion has been quoted at some time as authority upon which decisions have come to rest.

The problem remained as to whether the power of Congress to regulate foreign and interstate commerce was exclusive with Congress. According to Gibbons v. Ogden (41) Congress had the power to regulate commercial activity concerning more than one state. But did this mean that the states could not regulate such commerce if Congress had not yet acted? In the case of Cooley v. The Board of Wardens of the Port of Philadelphia (23) this question came before the court. This case was distinguished from Gibbons v. Ogden (41) because in that case a state regulation was involved which clearly conflicted with the unrestrained flow of interstate commerce, whereas in Cooley v. The Board of Wardens of the Port of Philadelphia (23)

the case involved the regulation of harbor pilots in a manner which was determined to facilitate rather than obstruct interstate commerce. The decision set forth the rule that states could regulate such interstate commerce when of such a local nature as to make uniform national control unnecessary. This would not prevent Congress from assuming control if and when such uniform national control seemed necessary. At first the Court held the regulation of railroad rates to be a valid subject of state regulation (71), but only nine years later the Supreme Court held void all state control over the rates charged by interstate railroads (131). Uniform control was deemed necessary.

By the middle of the 19th century the laissez-faire philosophy had slowly begun to lose ground. People were confronted with the clear choice of being ruled by giant commercial organizations or by representative government. The record indicates that the majority chose the latter course. Robert L. Stern made the following statement concerning the subject (93, p. 645):

Whether or not it be true as to lawyers and judges, philosophy and economic theory succumb to the facts in so far as the public is concerned. When the people began to suffer as a result of the unrestrained freedom of enterprise, they called for help from the only peaceful protective organization at their command, their Government. Their case was addressed to the national government rather than to the states, since the problems of an integrated, nationwide economy were obviously not remediable by state action. When the protests became sufficiently loud to arouse enough of the people's legislative representatives, Congress acted.

The Interstate Commerce Act of 1887, the Sherman Act of 1890, and the Federal Trade Commission Act of 1914 were manifestations of this public demand that business be regulated in the public interest. This legislation was all enacted under the power of Congress to regulate interstate commerce. Apart from the anti-trust laws and public utility regulation few of the statutes restrained business enterprise substantially. Most of this legislation was devised to protect consumers and small business from exploitation rather than to assist businesses in acquiring a measure of market power, as was the case during the 1930's.

In a number of cases the Supreme Court attempted to exclude such activities as manufacturing, production and mining from the definition of interstate commerce. It will be seen in Wickard v. Filburn (134) farther on that the Court later considered most of these statements as dicta, but they illustrate one concept of regulation of the time. In the case County of Mobile v. Kimble (26, p. 697) the Court stated, "Commerce with foreign countries and among the States, strictly considered, consists in intercourse and traffic, including in these terms navigation and the transportation and transit of persons and property, as well as the purchase, sale, and exchange of commodities". This dictum was an obvious attempt to circumscribe federal regulation of commerce.

In Kidd v. Pearson the Court quoted the definition above and went on to say that, if the term commerce were to include

manufacturing, "it is impossible to deny that it would also include all productive industries that contemplate the same thing. The result would be that Congress would be invested, to the exclusion of the states, with the power to regulate, not only manufacturers, but also agriculture, horticulture, stock raising, domestic fisheries, mining--in short every branch of human industry The power being vested in Congress and denied to the states would follow as an inevitable result that the duty would devolve on Congress to regulate all of these delicate, multiform, and vital interests--interests which in their nature are and must be local in all details of their successful management" (56, pp. 20-22).

The Court was convinced that "uniform regulation" meant only one thing--that the impact of regulation must be uniform throughout the nation. It will be seen later that this concept of uniformity was rejected in the case of Curran v. Wallace (27).

In the case of Oliver Iron Co. v. Lord (68, pp. 178-179) 1923, the Court said, "Mining is not interstate commerce, but, like manufacturing, is a local business subject to local regulation and taxation. Its character in this regard is intrinsic, is not affected by the intended use or disposal of the product, is not controlled by contractual arrangements, and persists even though business be conducted in close connection with interstate commerce".

Hammer v. Dagenhart (42) on the other hand, was directly

concerned with the limits of the federal power to regulate intrastate commerce having a connection in some way with interstate commerce. This case invalidated the Federal Child Labor Act of 1916 on the ground that Congress could not prohibit the interstate transportation of child-made goods, if the purpose or effect was to control conditions in productive industry. But in the great majority of cases decided during the same period, 1900-1930, the Court was upholding the application of the commerce power even to intrastate transactions. The principle that the power over interstate commerce extended to intrastate acts relating to interstate commerce was embodied in the Minnesota Rate Cases (61) and the Shreveport Case (Houston and Texas Ry. v. United States) (50). The Shreveport Case eliminated any seemingly mechanical line between local and interstate commerce. The railway company charged that the Interstate Commerce Commission had exceeded its constitutional powers by ordering the company to make its rates uniform between the two states it served. The Commerce Court upheld the validity of the order, and in this case the Supreme Court of the United States upheld the decree of the Commerce Court. The Court stated that Congress is empowered to enact all appropriate legislation for regulating interstate commerce necessary for its protection and advancement, growth and safety. Here the court used the terms "impinge upon or affect". Any commercial activity which impinged upon or affected interstate commerce was within the range of federal

control.

In Stafford v. Wallace (91), a case upholding the validity of federal regulation of certain activities and practices controlled under the Packers and Stockyards Act of 1921, the Court rejected the argument that Congress had no authority to control purely local sales of cattle after they had come to rest in the stockyards. The Court called the stockyards a "throat" through which the current of commerce was forced to flow. This throat was subject to federal control because it was indispensable to the continuity of interstate commerce. The court made the following statement which has subsequently been used as authority in other decisions (91, p. 520):

.... Whatever amounts to more or less constant practice, and threatens to obstruct or unduly to burden the freedom of interstate commerce is within the regulatory power of Congress under the commerce clause, and it is primarily for Congress to consider and decide the fact of the danger and meet it. This court will certainly not substitute its judgment for that of Congress in such a matter unless the relation of the subject to interstate commerce and its effect upon it are clearly non-existent.

The above quotation was used as authority in the case of Chicago Board of Trade v. Olsen (14), a case upholding the Grain Futures Act. In Olsen the Court declared, "Sales of an article which affect the country-wide price of the article directly affect the country-wide commerce in it" (14, p. 35). Stern declared that, if the Court adhered to the doctrines expressed in the Stafford and Olsen cases, there could be little doubt as to the power of Congress to use the Commerce Clause in regulating all the interrelated elements of the

great interstate industries (93, p. 632).

The Tenth Amendment to the Constitution of the United States reserves to the States those powers not delegated to the United States by the Constitution, nor prohibited by it. Among these reserved powers are powers which have traditionally come to be called police powers. These are the powers of the state to regulate virtually any enterprise or activity, which a state may regulate, for the protection of the health, morals, safety and general welfare of the people of the state. The preamble to the United States Constitution mentions the responsibility of the federal government in promoting the general welfare, and it is mentioned again in Article I, Section 8, Part 1 of the Constitution, in connection with the power to spend and tax; but it is generally conceded that the federal government has no explicit substantive power to enact regulatory legislation expressly on the basis of the general welfare of the people.

Congress has therefore used its delegated powers to reach some of the same ends as states reach under their police powers. The power of Congress to regulate interstate commerce has been used as the peg upon which the greater amount of this police type legislation has been attached, so much so, in fact, that the commerce power has come to be referred to informally as the federal police power. The case of Hammer v. Dagenhart (42), dealt with legislation of this type, and, although that legislation was struck down, it was soon replaced

in substance and upheld by the Court in the case United States v. Darby (125).

The cases sustaining the constitutionality of such statutes as the Lottery Act (13), the Pure Food and Drug Act (132), the White Slave Act (49), the Motor Vehicle Theft Act (9), and the Animal Industries Act (99) all dealt with laws which were in substance police measures enacted in the interests of the public health and morality. The impact of the regulations came to bear mainly upon regulated subjects at the point of interstate transportation of prohibited commodities or persons.

Most of the early labor legislation was a part of the comprehensive regulatory legislation applied to the railway transportation industry. Maximum hours and safety appliance requirements were set forth, and employers were restrained from interfering with the right of employees to choose their own representatives for collective bargaining. The legislation and the cases supporting it were important for establishing the principle of protecting interstate commerce from injury from any source, interstate or intrastate.

At the time of the passing of the National Industrial Recovery Act in 1933 there appeared to be only one case with much remaining potency which might furnish precedent for opposition to the Act on constitutional grounds. That was Hammer v. Dagenhart (42), which had invalidated the child labor legislation and the dissent by Mr. Justice Holmes in

that case was beginning to carry more weight than the holding. In fact, that dissent has become a classic bit of legal literature. The theme of the dissent was that Congress may carry out its views of public policy whatever indirect effect they may have upon the activities of the states. "The national welfare as understood by Congress may require a different attitude within its sphere from that of some self-seeking state. It seems to me entirely constitutional for Congress to enforce its understanding by all the means at its command" (42, p. 278). Mr. Justice Holmes went on to point out in detail that the decision in Hammer v. Dagenhart did not square with previous decisions of the Court. Three other justices concurred in the dissenting opinion.

Title I of the National Industrial Recovery Act (115) was passed for the avowed purpose of encouraging national industrial recovery and fostering fair competition among firms and industries. An emergency was declared to exist, and it was declared to be the policy of Congress to remove obstructions to the free flow of interstate and foreign commerce (115). Business men were to be encouraged to eliminate wasteful competitive practices, under codes subject to Government approval, so that they could halt the decline in prices, pay higher wage bills and restore business to a healthy condition. Section 3 of Title I set forth the framework for creating codes of fair competition. The Act also set forth a framework for minimum pay, maximum hours and employer-employee relations

(115, Sec. 6). Section 9(c) of Title I set forth a framework for assisting the states in regulating oil production by prohibiting interstate and foreign transportation of oil produced in excess of state allowables. This was called "hot oil". Oil prices were depressed relatively to a greater degree than prices for most other commodities due to the peculiar ratio between fixed and variable costs and due to the new oil fields of Oklahoma City and East Texas (94, pp. 35-36). Section 9 of Title I was set up to remedy this situation by assisting the respective producing states in controlling production of oil. In the case of Panama Refining (69) the Court struck down Section 9(c) of Title I as an unconstitutional delegation of power to the President of the United States. This marked the first time in American history that a federal law had been nullified on that ground. Stern believed the deficiency was merely one of faulty drafting rather than of principle (93, p. 658). But this case didn't answer the question concerning the validity of the remainder of Title I. This question came up in the case of United States v. Schechter Poultry Corp. (128).

The Court of Appeals for the Second Circuit held trade practice provisions of the Live Poultry Code for New York City lawful, but the wage and hour provisions unlawful. The Code had been worked out and established under Title I, Section 3 of the Recovery Act. The case came to the Supreme Court as A.L.A. Schechter Poultry Corp. v. United States (1).

The Court was convinced of the trivially local nature of some of the practices involved by very effective counsel for the Schechters'. The Court held that the Poultry Code did not come within the power of Congress under the commerce clause because the impact of the activities in question did not have a direct effect upon Interstate Commerce. Edward Corwin saw in the decision a return to the "direct-indirect" formula of determining responsibility of control (25, p. 205). Fortunate for the Government's side was the fact that the Court found the defendants' business activities in question purely local in nature, so the formula mentioned above didn't derive much substance from the holding of the case. The Court also found an unlawful delegation of power to the Administrator without standards sufficiently definite to limit his discretion.

Under Section 3 of Title I of the Recovery Act the Bituminous Coal Code was created. This code fixed minimum prices for coal and minimum wages for miners and guaranteed rights of workers to bargain. When the Recovery Act fell, the bituminous coal industry sought legislation which would preserve the benefits of the Code. The industry had suffered from low prices and destructive competition for many years before the 1930's. The outcome of this effort to get new legislation enacted was the Guffey Coal Act. This Act restored minimum prices for coal, minimum wages and rights for workers. The validity of the Act was challenged by James Carter in the case of Carter v. Carter Coal Co. (12). The

holding was that, following Schechter (1), the wages, hours and labor relations part of the Act were not valid because of the indirect effect of the coal industry upon interstate commerce. The price-fixing regulations were sustained because they were found to pertain to interstate sales and competitive intra-state transactions in the same markets. The vote in this case was five to four.

In dissenting in the Carter (12) case, Justice Cardozo asserted that the Court had vainly sought to reduce a great principle of constitutional law to comprehensive statement in an adjective. He was referring to the direct-indirect formula in regards to the effect of an activity upon interstate commerce. He felt that the commerce clause must be interpreted with flexibility of meaning. "The power is as broad as the need that evokes it" (12).

This formula does not need to be expounded at this point, because Carter (12) was the last case in which it was used in connection with determining the power of Congress to act in the interest of interstate commerce. The study of the development of constitutional law during the period from 1934-1937 converges into a study of the tremendous economical and social upheaval, and from there into a study of the personalities and philosophies of the justices presiding at that time.

In 1935 Congress passed the National Labor Relations Act to replace labor provisions of the Recovery Act. The Court had struck down similar legislation in the Carter (12) case in

1936, but in 1937, in the case of NLRB v. Jones and Laughlin Steel Corporation (65), Mr. Justice Roberts joined the four liberals on the court to uphold the right of Congress to regulate labor and employee relationships under the Act. In Santa Cruz Fruit Packing Co. v. NLRB (80), the court made it clear that the industries at the beginning of the flow of commerce, producing raw materials within a state for shipment outside were subject to the Act since labor disputes in such concerns would obstruct the interstate movement of products as well as raw materials.

In NLRB v. Fainblatt (65) the Labor Relations Act was held applicable to a small processor of women's garments who delivered the finished products to the owner of the factory and thus did not himself ship them across state lines. In fact, after Mr. Justice Roberts reversed his stand and joined the liberals in the Court, the New Deal social and economic legislation began to be upheld with regularity. Mr. Justice Van Devanter, a reactionary, retired in 1937, and Mr. Justice Black succeeded him at the beginning of the October Term, 1937. Mr. Justice Sutherland, who had been voting against regulation under the Commerce Power, retired in January, 1938, and Solicitor General Stanley Reed took his place (93, p. 682).

Before the philosophy of the Court changed so dramatically, through the change of Mr. Justice Roberts stand on validity of commerce legislation and the change in personnel, the Court

had been forced to deal with the validity of the Agricultural Adjustment Act of 1933. This Act was based on the power of Congress to tax and to spend, rather than upon the power to regulate interstate commerce, but the Act met the same end as Title I of the National Recovery Act, which brings one to think that the Court was opposed to the general policy of Government control of enterprise.

The Agricultural Adjustment Act contained two methods of handling the imbalance between supply and demand for agricultural products. The problem obviously required a different approach from that attempted in the National Recovery Act, because on most farms labor and management were inseparable, and farm firms were generally quite small as compared to the firms at which the N.R.A. was directed. Firstly, when farm commodity prices were determined to be below those of the base period 1909-1914, (except for tobacco) production of the specific basic commodities was to be reduced by payment of benefits to farmers who agreed to reduce their acreage (114, Title I, Part 2). To obtain the revenue for expenses incurred in this program a processing tax was to be levied on the processing of agricultural commodities. This processing tax was held by the Court to violate the Tenth Amendment (because the tax was used to regulate agricultural production), in United States v. Butler (104), decided in January, 1936. Part 2 of Title I also empowered the Secretary to issue licenses to persons handling agricultural commodities in the current of

interstate or foreign commerce, which contained either minimum price controls or restrictions upon the quantities of the marketing of milk and certain fruits and vegetables. In the Summer of 1935, after the Schechter (1) decision, the statute was revised to convert the licenses into "marketing orders," to provide standards sufficient to meet the test of delegation of power, and to make orders applicable only to the handling of products in interstate or foreign commerce or those directly affecting such commerce (119).

Congress also attempted to regulate the amount of cotton and tobacco marketed or produced by statutes based jointly on the commerce and taxing powers. The Bankhead Cotton Control Act (116) and the Kerr-Smith Tobacco Act (117), both imposed taxes on the ginning of cotton and the sale of tobacco, but exempted an amount allotted to each farmer as part of a crop reduction program. A similar statute for potatoes was enacted in August, 1935 (120). The Butler (104) case was assumed to establish the unconstitutionality of these laws and they were repealed shortly after that case was decided (121).

In 1935 Congress amended the marketing order provisions of the Agricultural Adjustment Act of 1933, presumably with the hope that they would be more acceptable from the constitutional standpoint. In 1937 these provisions were incorporated into the Agricultural Marketing Agreement Act (123). This Act was subsequently upheld as to constitutionality in three important decisions by the Supreme Court. In the case of United

States v. Rock Royal Co-operative, Inc. (127) the Court held that intrastate milk commingled with interstate milk was subject to the power of Congress to regulate prices and sales. The Court stated, "The federal commerce power, where it exists, is complete and perfect" (127, p. 568). In H. P. Hood & Sons v. United States (51) the Court overruled objections, on constitutional grounds, to the Agricultural Marketing Agreement Act of 1937, and to certain features of an order of the Secretary of Agriculture made thereunder, upon the authority of the Rock Royal (127) case.

In the case of United States v. Wrightwood Dairy Co. the Court stated, "The national power to regulate the price of milk moving in interstate commerce into a market area extends to such control over intrastate transactions there as is necessary and appropriate to make the regulation of the interstate commerce effective; it includes authority to regulate the price of intrastate milk, the sale of which, in competition with interstate milk, affects adversely the price structure and federal regulation of the latter" (129, p. 121). This latter case follows the Shreveport case (50) quite directly. The reader will remember that these marketing order provisions of the 1935 Agricultural Act as amended in 1935 did not fall under the Butler (104) decision, but remained effective after the basic commodity control provisions fell.

There was a great deal of litigation in lower courts over various affects of the marketing order provisions in

regards to points of discrimination, but the Supreme Court upheld the constitutionality of the legislation in every instance, even in the Butler (104) decision. However, the Butler decision left Congress without controls over what was designated as basic commodities, and without a means of supplementing incomes of farmers in the interest of the "parity" goal. In 1935 Congress created the Soil Conservation Service and accompanying program (118) and after the collapse of the basic commodity control provisions of the Agricultural Adjustment Act of 1933 some farm income supplementing provisions and crop control provisions of a purely voluntary nature were tacked on to the Soil Conservation Act (122). The constitutionality of these provisions was never challenged, presumably because no one had standing to do so because of their voluntary nature. Under these stop-gap provisions payments were made to farmers who would reduce acreage of certain crops, in the interest of conserving the natural resources of the country.

In 1938 a new Agricultural Adjustment Act was enacted by Congress with the same objectives of the earlier Adjustment Act (124). This act was explicitly based upon the Commerce Clause. Marketing quotas for basic commodities would be assigned by the Secretary of Agriculture during years when a crop surplus appeared to be in the making. The tobacco growers were the first to challenge the legality of the Act (63). The appellants at this time still hoped for a judgment against the validity of the Act on the basis that it was regulation of

production and therefore could not be reached by Congress under the Commerce Power. The Court avoided direct confrontation with the question of whether or not Congress could regulate production by holding that the Act "does not purport to control production, but regulates commerce in tobacco through marketing" (63, p. 47). However, in the opinion the Court stated (63, p. 48):

Any rule, such as that embodied in the Act, which is intended to foster, protect and conserve that commerce, or to prevent the flow of commerce from working harm to the people of the nation, is within the competence of Congress. Within these limits the exercise of the power, the grant being unlimited in its terms, may lawfully extend to the absolute prohibition of such commerce, and a fortiori to limitation of the amount of a given commodity which may be transported in such commerce. The motive of Congress in exerting the power is irrelevant to the validity of the legislation.

If this opinion was any indication of the direction in which the Court was moving, both the Butler (104) decision and the decision in Hammer v. Dagenhart (42) would soon be overruled in effect, if not overtly. Under the Butler decision, if the subject of regulation was production, it was beyond the power of Congress to regulate, even though such production was directly related to interstate commerce. But one might deduce that, if the motive of Congress in exerting the power is irrelevant to the validity of the legislation, then whether the activity regulated were marketing or production would be irrelevant. The opinion also suggested that Congress might regulate the quantity of a commodity sold regardless of the nature of the product, whereas in Hammer v. Dagenhart Congress

seemed to be limited to regulating the movement of harmful products.

In Currin v. Wallace (27) the Court had already held tobacco marketing activities to be a valid subject of regulation under the Commerce Power. That case dealt with the Tobacco Warehouse Inspection Act of 1935 which authorized the Secretary of Agriculture to establish standards for tobacco grading. The Act also authorized the Secretary to select the warehouses which would be regulated, since there were not enough inspectors to make possible the establishment of standards in all warehouses. The plaintiffs, tobacco warehousemen, charged that the regulations were invalid because of the lack of uniformity of their impact upon different warehouses. Some warehouses were regulated and some were not. The Court held that there was no requirement to hold Congress to the making of uniform rules, that the exercise of the Commerce Power was subject to the requirements of the Fifth Amendment, but that there was no equal protection clause in the Fifth Amendment, as in the Fourteenth Amendment.

Regarding uniformity of impact of legislation the Court said (27, p. 14):

If it be assumed that there might be discrimination of such an injurious character as to bring into operation the due process clause of the Fifth Amendment, that is a different matter from a contention that mere lack of uniformity in exercise of the commerce power renders the action of Congress invalid. For that contention we find no warrant. It is the essence of the plenary power conferred that Congress may exercise its discretion in the use of the power. Congress may choose the commodities and places to which its regulation shall

apply. Congress may consider and weigh relative situations and needs. Congress is not restricted by any technical requirement but may make limited applications and resort to tests so that it may have the benefit of experience in deciding upon the continuance or extension of a policy which under the Constitution it is free to adopt. As to such choices, the question is one of wisdom and not of power.

The plaintiffs also charged that Congress had delegated legislative power to tobacco growers by allowing them to kill the legislation by a two-thirds referendum vote. The Court distinguished this case from that in Carter v. Carter Coal Co. (12) by contending that this case was not a case where a group of producers made a law and forced it upon a minority (27, p. 15). The Court defined the referendum used in this case as a restriction which Congress had imposed upon itself. This referendum would thus constitute little more than an opinion poll in the strictest legal sense.

In Currin v. Wallace there was also the question of power of Congress to regulate the conditions of sale of tobacco not going into interstate or foreign commerce. The Court held that, since the tobacco was all sold at virtually the same time, and since interstate and intrastate tobaccos were intermingled, the power of Congress extended also to intrastate tobaccos. The reader should note that this case preceded Mulford v. Smith (63), and that the question of the power of Congress to regulate the quantity of a commodity marketed was not raised here in Currin v. Wallace. But the case of Mulford v. Smith dealt with the question of the power

of Congress to regulate the quantity of the tobacco sold through tobacco warehouses.

One of the more important cases in all constitutional law was the case of United States v. Darby (125). In this case the Court upheld the Fair Labor Standards Act of 1938, which provided for fixing minimum wages and maximum hours for employees engaged in the production of goods for interstate commerce, with increased compensation for overtime. Stating the proposition very crudely, this case did a lot of house-cleaning in the area of constitutional law. The Court recognized that the time had come when it could no longer be asserted that the power of Congress to restrict or condition interstate commerce was limited to articles in themselves deleterious (125, p. 103). The Court cited Mulford v. Smith (63) and other cases which had not squared with Hammer v. Dagenhart (42). Hammer v. Dagenhart was explicitly overruled (42, p. 115), and Carter v. Carter Coal Co. (12) was differentiated from the case being considered.

The Court reiterated the necessity for Congressional control over the movement of intrastate commerce in certain instances as follows (125, p. 121):

Congress, having by the present Act adopted the policy of excluding from interstate commerce all goods produced for the commerce which do not conform to the specified labor standards, it may choose the means reasonable adapted to the attainment of the permitted end, even though they involve control of intrastate activities. Such legislation has often been sustained with respect to powers, other than the commerce power granted to the national government, when the means chosen, although not themselves within the granted power, were nevertheless

deemed appropriate aids to the accomplishment of some purpose within an admitted power of the national government.

Robert F. and Robert E. Cushman point out that by 1941, the time of the Darby case, the majority of the thinkers of the country were beginning to view the Commerce Power as a legitimate tool for seeing to it that the facilities of interstate commerce are not used by any one, in any manner, to do any kind of harm. "We had come to realize that serious evils which menace the health, safety, and welfare of the nation are spread and even generated by our vast national system of transportation and communication and by our continent-wide network of interstate markets" (28, p. 396).

In the Darby case the Court returned to interpreting the Commerce Power as a plenary power limited only by the Constitution.

Our conclusion is unaffected by the Tenth Amendment which provides: "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." The amendment states but a truism that all is retained which has not been surrendered

From the beginning and for many years the amendment has been construed as not depriving the national government of authority to resort to all means for the exercise of a granted power which are appropriate and plainly adapted to the permitted end (125, p. 124).

In Ashwander v. TVA (2) the Court even held that under the property clause of the Constitution Congress could sell power derived from a project created under other Constitutional Powers, such as in this case, the powers of Commerce and War.

In the case of labor standards it was practically impossible for one firm or even one state to adopt policies which resulted in a greater share of total returns to labor. This would have put such a firm or state in an unfavorable competitive position relative to other firms or states. This was the rationale behind the federal control of goods flowing in channels of commerce for the purpose of regulating conditions of production and distribution. Basically the same rationale underlies the regulation of agricultural production, in respect to quantity. It was thought that one farmer, one farmer association or even one agricultural state could not benefit by restricting their marketing of most agricultural commodities. Thus, it was felt that a national program of production restriction was called for.

It was only a short step in terms of both time and doctrinal development from the Darby (125) case to Wickard v. Filburn (134). The supply control program pertaining to tobacco had been upheld by the Court in the Mulford case (63), even though some intrastate tobacco was inevitably affected by the program. The Secretary of Agriculture did not apply supply controls to wheat production until the crop year of 1941. The Court was called upon to expand its interpretation of the Commerce Power as applied to agricultural quotas because wheat production involved the problem of home consumption which was a purely insignificant factor in regards to tobacco production. Many farm families produced wheat for

family consumption as well as for feed for their livestock. The question was, Was production of wheat which never left the farm a function of interstate commerce? The Appellee argued that this was regulation of production and consumption of wheat, and that such activities were beyond the reach of Congressional power under the Commerce Clause, since they were local and indirect, in respect to their effects upon interstate commerce.

The Court classified as dicta previous statements in its opinions listing activities such as "production", "manufacturing", and "mining" as strictly "local" and not subjects to be regulated under the Commerce Power because of only "indirect" effects on such commerce (134, pp. 119-120). Quoting Mr. Justice Holmes in Swift & Co. v. United States (96, p. 398) the Court stated, "Commerce among the States is not a technical legal conception but a practical one, drawn from the course of business".

The Court went on to lay the past dicta to rest by stating, "Whether the subject of the regulation in question was 'production', 'consumption', or 'marketing' is not material for purposes of deciding the question of federal power before us" (134, p. 120). The court reached the holding in this regard that the wheat marketing quota provisions applied to wheat not intended in any part for commerce but wholly for consumption on the farm. This holding remains today as the high-water mark in Court interpretation

of the scope of the power of Congress to exercise its regulation of enterprise under the Commerce Power.

Before reaching this holding, the Court made a study of the economics of the wheat industry, finding that annual exports of wheat and flour from the United States decreased from 25% of the national output during the period 1920-1930 to less than 10% during the period 1930-1940. The Court noted that the "decline in the export trade has left a large surplus in production which, in connection with an abnormally large supply of wheat and other grains in recent years, caused congestion in a number of markets; tied up railroad cars; and caused elevators in some instances to turn away grains, and railroads to institute embargoes to prevent further congestion" (134, p. 125). The Court went on to point out that the collective effect of producers who consumed their own wheat had a far from trivial effect upon the wheat market, for many of them would have purchased wheat for consumption had they not raised it themselves (134, p. 124-125). It was also determined that price of wheat was determined by total supply, including that on farms.

Of the fairness of the Act the Court made an almost classic statement (134, p. 129):

It is said that this Act, forcing some farmers into the market to buy what they could provide for themselves, is an unfair promotion of the markets and prices of specializing wheat growers. It is of the essence of regulation that it lays a restraining hand on the self-interest of the regulated and that advantages from the regulation commonly fall to others. The conflicts of economic interest between the regulated and those who

advantage by it are wisely left under our system to resolution by the Congress under its more flexible and responsible legislative process. Such conflicts rarely lend themselves to judicial determination. And with the wisdom, workability, or fairness, of the plan of regulation we have nothing to do.

It appears that one would search Constitutional Law in vain for a model for economic development, for example, or for the solution to a particular social or economic problem. Yet in devising these designs for reaching desired ends, one cannot ignore Constitutional Law. If a person designing policy merely decides to propose means which seem reasonable, his policies will probably not violate constitutional principles frequently, but that is about all that can be said. One cannot be sure. Most cases in Constitutional Law probably involve litigants on both sides of the issue who feel that they have followed reasonable policies or means in regards to the activities in question. If a person seeks to follow Constitutional Law in designing policies or means there is no way for him to know whether or not he is indeed doing so. But a knowledge of decisions of the Court in regards to interpretation of the Constitution in specific historical instances is a useful guide to the policy builder.

Among other things Mr. Filburn charged that the regulatory functions of the Agricultural Adjustment Act deprived him of property without due process of law, contrary to the Fifth Amendment. The comments of the Court concerning this charge will be used as guiding principles later on in the analysis of suggested alternative agricultural programs. The Court

commented, "An Act of Congress is not to be refused application by the courts as arbitrary and capricious and forbidden by the Due Process Clause merely because it is deemed in a particular case to work an inequitable result" (134, p. 130). Commenting further the Court stated, "Appellee's claim is not that his quota represented less than a fair share of the national quota, but that the Fifth Amendment requires that he be free from penalty for planting wheat and disposing of his crop as he sees fit" (134, p. 130).

The Court examined the alternatives faced by the non-cooperator and found that by following the most costly alternative, Filburn could have received for his wheat a higher price per bushel, after penalty, than the world market price. The Court assumed that the market price for wheat in the absence of the program would have approximated the world price "based on the natural reaction of supply and demand" (134, p. 131). Thus, there was no finding that Filburn's property had been significantly depreciated by the program. "We can hardly find a denial of due process in these circumstances, particularly since it is even doubtful that appellee's burdens under the program outweigh his benefits. It is hardly lack of due process for the Government to regulate that which it subsidizes" (134, p. 131).

The greater part of the opinion in Wickard v. Filburn (134) was concerned with the power of Congress to regulate the production of wheat for consumption on the farm where

grown. The history of federal Government regulation of enterprise was presented, supported by many leading cases. A few comments were made in connection with the holding that the retroactive effects of the legislation in question did not deprive Mr. Filburn of property, and the case Mulford v. Smith (63) was cited, but only for comparison. In holding that the program of regulation had not deprived Mr. Filburn of property without due process of law the Court did not list a single supporting case or any case for purposes of comparison. A logical analysis of the question was presented in the opinion without supporting citations. This is a critical question in regards to the problem of determining the probable legality of suggested regulatory programs. The issue was not a critical one at the time of Wickard v. Filburn for economic reasons. The price of land was quite low, and the prices of agricultural commodities were generally quite low.

The point is made in an earlier chapter that one of the foremost effects of agricultural programs has been that of increasing land values. Among the many factors working to increase property values in respect to agricultural land, agricultural price and income supporting programs have been one of the more important. At no time since 1933 could farmers construct a convincing argument supporting the claim that agricultural programs had significantly depreciated the value of their property. But this question does become critical today as new programs threaten to place greater

emphasis upon individuals than upon property.

According to Edward S. Corwin the Fifth and Fourteenth Amendments were originally procedural safeguards (25, p. 215):

The phrase "due process of law" comes from chapter three of 28 Edw. III (1335), which reads: "No man of what state of condition he be, shall be put out of his lands or tenements nor taken, nor disinherited, nor put to death, without he be brought to answer by due process of law". This statute, in turn, harks back to the famous chapter 29 of Magna Carta (issue of 1225), where the King promises that "no free man shall be taken or imprisoned or deprived of his freehold or his liberties or free customs, or outlawed or exiled, or in any manner destroyed, nor shall we come upon him or send against him, except by a legal judgment of his peers or by the law of the land". (Edward S. Corwin. The Constitution and what it means today. Eleventh Ed. Princeton, N. J. Princeton University Press. 1954).

Mr. Justice William Johnson once attempted to point out the essence of the original meaning of "due process of law" in the case of Bank of Columbia v. Okely (3) quoted by Corwin (25, p. 215-216).

As to the words from Magna Charts after volumes spoken and written with a view to their exposition, the good sence of mankind has at length settled down to this: that they were intended to secure the individual from the arbitrary exercise of the powers of government, unrestrained by the established principles of private rights and distribute justice.

It is not commonly recognized that the fundamental principles embodied in the Constitution were also a part of common law at the time of the adoption of the Constitution. The common law had not at that time developed to the point of defining adequately the working relationship between the States and the federal Government. Under common law procedural due process of law, property or liberty could not be

deprived of a citizen apart from a good cause, the proper writs, trial and so forth, the adequacy of the cause being determined by the courts. Mr. Corwin suggests that Mr. Justice Johnson's definition, stated in 1819, was broad enough to include a second type of "due process" known as substantive due process. The highest New York court ushered in substantive due process in the case of Wynehamer v. People (136). In this case the New York court invalidated a prohibition law which required the destruction of liquors in existence at the time of its effectiveness. It was held that the law destroyed property not within the power of government to destroy even by the forms of due process of law. According to Mr. Corwin the term "due process of law", dropped out of the clause in effect, leaving the clause "no person shall be deprived of property" (25, p. 216). Shortly after the Wynehamer case the United States Supreme Court invalidated the Missouri Compromise in the Dred Scott case (85). A part of the reason given by the Court was that the act of Congress deprived a citizen of the United States of his liberty or property (76, p. 555).

The development of this theory that the substance of the law itself could be held void by courts for want of due process proceeded slowly. Mr. Justice Miller rejected the theory in the Slaughterhouse cases (28, p. 541), and in a number of subsequent cases (28, p. 554). In Munn v. Illinois (64), Mr. Chief Justice Waite said in the opinion that the legislation in question, if it seemed unreasonable, could be

reached by electing a legislature which would repeal the offending legislation. But the Court, in the holding, did not find regulation of grain warehouses invalid, because these businesses had become clothed with a public interest. This property, the Court said, ceases to be exclusively private property once it acquires this public character. In subsequent cases the Court attempted to apply this public interest test and found no criteria which would effectively separate those businesses which were so clothed and those which were purely of a private nature.

In the case of State Ice Co. v. Liebmann (92), Mr. Justice Brandeis condemned the "public interest" doctrine in a dissenting opinion which was soon to become the majority opinion. In this dissenting opinion he said (92, p. 280):

The notion of a distinct category of business "affected with a public interest" employing property "devoted to a public use" rests upon historical error In my opinion, the true principle is that the State's power extends to every regulation of any business reasonably required and appropriate for the public protection. I find in the due process clause no other limitation upon the character or the scope of regulation permissible.

Only one year later the case of Nebbia v. New York (67) involved the validity of an act of the Legislature of New York establishing a Milk Control Board with power to fix minimum and maximum retail prices for carry-out milk. Nebbia, the proprietor of a grocery store, charged among other things, that the statute and the order contravened the due process clause of the Fourteenth Amendment. The Court reviewed the

economic and technical situation in the state dairy industry, pointing out the essential nature of milk in the diet and that the failure of producers to receive a reasonable return for their labor and investment over an extended period threatened a relaxation of vigilance against contamination. The Court said that economic conditions had destroyed the purchasing power of milk producers for industrial products, had broken down the orderly production and marketing of milk, and had seriously impaired the agricultural assets supporting the credit structure of the state and its local governmental subdivisions (67, p. 519). The Court did not find the dairy industry a public utility, nor was there any suggestion of monopolistic practice. But the Court found no constitutional principle preventing the regulation. The Court stated in the opinion, "The due process clause makes no mention of sales or of prices any more than it speaks of business or contracts or buildings or other incidents of property" (67, p. 531).

Then the Court described in liberal terms the power of states to regulate enterprise (67, p. 537):

So far as the requirement of due process is concerned, and in the absence of other constitutional restriction, a state is free to adopt whatever economic policy may reasonably be deemed to promote public welfare, and to enforce that policy by legislation adapted to its purpose. The courts are without authority either to declare such policy, or, when it is declared by the legislature, to override it. If the laws passed are seen to have a reasonable relation to a proper legislative purpose, and are neither arbitrary nor discriminatory the requirements of due process are satisfied, and judicial determination to that effect renders a court functus officio.

Business interests had long looked upon price control as being outside the power of Government to regulate. In Nebbia the Court said, "Price control, like any other form of regulation, is unconstitutional only if arbitrary, discriminatory, or demonstrably irrelevant to the policy the legislature is free to adopt, and hence an unnecessary and unwarranted interference with individual liberty" (67, p. 502).

Most of the above comments could be applied equally as well to regulatory legislation passed by Congress, in respect to the requirements of the Fifth Amendment, except for two details. Congress does not regulate enterprise explicitly under welfare powers, and the Fifth Amendment, unlike the Fourteenth, does not explicitly require uniform protection of the laws. Mr. Corwin states that, although the Fifth Amendment contains no "equal protection" clause, this does not signify that the Court will not pass upon the soundness of the factual justification urged in support of a specially drastic discrimination by the National Government against a particular class of its citizens (25, p. 218).

Mr. Corwin is convinced that the Courts are presently following the doctrine of "assumed validity" of legislation in most cases affecting regulation of property use and enterprise, but that the United States Supreme Court has not explicitly relinquished its power of review in this area (25, pp. 219-220).

Mr. Justice Holmes has left to posterity some statements

which point out beyond question that this process of balancing the rights of the individual with the rights of the public to limit individual rights is quite imprecise, and will remain so. In several cases Mr. Justice Holmes held up for examination both the power of the public to regulate enterprise and property use and the rights of individuals to transact business and use property according to their desires. In Block v. Hirsch he made the following statement in the opinion of the Court (6, p. 155):

The fact that tangible property is also visible tends to give a rigidity to our conception of our rights in it that we do not attach to others less concretely clothed. But the notion that the former are exempt from the legislative modification required from time to time is contradicted not only by the doctrine of eminent domain under which what is taken is paid for, but by that of the police power in its proper sense, under which property rights may be cut down, and to that extent taken without pay.

In the case of Pennsylvania Coal Co. v. Mahon (72), Mr. Justice Holmes pointed out that Government could hardly go on if to some extent values incident to property could not be diminished without paying for every such change in the general law. But in the same case he emphasized limits upon the power of Government to regulate property as follows (72, pp. 415-416)

As long recognized, some values are enjoyed under an implied limitation and must yield to the police power. But obviously the implied limitation must have its limits, or the contract and due process clauses are gone. One fact for consideration in determining such limits is the extent of the diminution. When it reaches a certain magnitude, in most if not in all cases there must be an exercise of eminent domain and compensation under the act. So the question depends upon the particular facts The general rule at

least is, that while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking. We are in danger of forgetting that a strong public desire to improve the public condition is not enough to warrant achieving that desire by a shorter cut than the constitutional way of paying for the change this is a question of degree--and therefore cannot be disposed of by general propositions.

Precedent in this area of law is a valuable guide, but not a perfect one in an age of rapid technological change and changing concepts of property. Again, this discussion pertains directly to regulation of property under the police power of the states, but in regards to the requirements of the Fifth Amendment, the fundamental principles are much the same.

As stated before, the impact of agricultural price and income supporting programs upon property values from 1938 to the present has been positive. The holding in the case of Wickard v. Filburn (134) established a very clear precedent in regards to its interpretation of the nature of the impact of the regulatory legislation upon property values. But it is possible that future agricultural programs might not continue to enhance property values. The question concerning the extent to which conceivable programs could depreciate property values in attaining desired goals without contravening the Fifth Amendment is one which must be considered. To what extent can Congress "regulate that which it subsidizes"?

Allotments under the Agricultural Adjustment Act of 1938

Under the 1938 Act the Soil Conservation Service did not purport to regulate agricultural output, but the entire Act of 1938 was shot through with evidences of rudimentary conservation principles. Not only were practice payments to be made to farmers for encouraging acceptable conservation practices, many of which were still primarily income supporting devices, but the acreage allotments were to be made in certain instances upon the basis of conservation principles. The Act specified that in the case of corn, for example, four tests would be used to determine the allotment on an individual farm: (1) tillable acres, (2) crop rotation practices, (3) type of soil, (4) topography (106). When this language was coupled with the overall declaration of policy and purpose contained in the Act, namely, to conserve national resources, to prevent the wasteful use of soil fertility, and to preserve, maintain and rebuild farm and ranch land resources in the national public interest (105), one is led to conclude that the central purpose of the Act was conservation rather than regulation of output of agricultural commodities. In reality, participation in Soil Conservation Service programs has always been voluntary and conservation principles have never been used for determining allotments. Determination of allotments upon conservation principles would have been possible only as coupled to a complex legal system for determining the extent to which the

system of allocation of crops took the farmer's property; then compensatory payments could have been made to the farmers on that basis. It could have resulted in an unworkable legal-economic-political system if for no other reason than a lack of a suitable definition of conservation. In 1938 a definition of conservation including ample cognizance of the social, economic, political and physical ramifications of land use practices was unknown.

The historical land use pattern was used instead of conservation principles as a guide for determining allotments. This might be considered the converse of a conservation basis of allocation in many of its results. Farmers who had been lured into various conservation practices since 1933 were penalized, due to the fact that their history of intensive cropping had been altered in favor of more extensive land use in most instances. The Act did include provision for redress of grievances over allocation of allotments in cases of hardship. It is not difficult to understand why the simple historical basis for allocation was used, but it is not clear why the statement of purpose in the Act was not changed until 1961, at which time all reference to conservation as a consideration in allocating allotments was dropped, including Section 1329(b).

Readers of acts of Congress should not be surprised if the statements of policy and purpose at the beginning of the acts read more like philosophy than law. These sections are

reserved as one of the few places outside campaign speeches where congressmen may express to the public their sentiments, hopes and aspirations as law makers.

If allotments were allocated either on the basis of conservation principles or some combination of present efficiency and efficiency over time, this would constitute a type of zoning of land use practices by Congress under its Commerce Powers. It seems apparent to the writer that this is the very interpretation which Congress has tried to avoid by making allocations of allotments on the basis of historical land use.

Congress has become involved in allocation plans which bear some resemblance to zoning. In the case of corn acreage allotments, for example, the Secretary of Agriculture has specified "commercial corn-producing areas" on the basis of average corn production per farm in a county over a ten year period (108, 4a). Outside these commercial corn-producing areas there was not much incentive to farms to encourage cooperation with an acreage restricting program. Inside the area the incentives were stronger. An allocation of quotas on an efficiency basis might require the opposite treatment. Production of corn might be restricted in inefficient areas while there might be no restriction of production in efficient areas.

Restriction of production in commercial areas probably maintained higher prices for the livestock to which the farmers

in the noncommercial areas fed their corn. This difference of treatment of corn producers within and without an area determined by law has qualities similar to zoning, but the penalty for noncooperation was purely economic and never very severe in the case of corn-production restriction programs. The fact that there was never a severe economic penalty for noncooperation in the commercial corn-producing areas probably precluded any Court tests of the legislation as being discriminatory, arbitrary and confiscatory. But this system of allocation has undoubtedly functioned to penalize the areas which have made the most rapid gains in productivity (47, pp. 1-26).

The question arises, would the Fifth Amendment be violated in principle any more by restricting production in inefficient areas and not in efficient areas than vice versa? From the practical standpoint it must be recognized that production in inefficient and moderately efficient areas would have to be virtually eliminated in order to bring supply into desired relation with demand at reasonable prices. This is more harsh regulation, in theory at least, than restricting production by 10 to 20 per cent, even though the restriction in the latter case resulted in the reduction of more absolute quantities of corn per farm in efficient areas than the regulation eliminating corn production altogether on inefficient farms.

After a careful study of past regulation of agricultural production one cannot escape the conclusion that it has been

generally felt among law-makers that the allocation of allotments on the historical pattern is the most equitable of all possible alternatives. Some may doubt that history has proved them correct. Certainly the technique has required a minimum of imagination and leadership. In this sense, at least, the historical land use pattern as a basis for allocating crop production has been economical.

Congress, in regulating agricultural production, has avoided entanglement in property concepts, even while at times creating arrangements affecting the farm operator in much the same way as property interests. H. W. Hannah has pointed out that there is no federal legislation requiring the farmer to engage in or refrain from any land use practices of any kind. Ineligibility for benefits and the imposition of cash penalties on those who market in excess of their quota have been the only sanctions thus far imposed on a non-cooperator (43). However, in the case of tobacco production, for example, penalties for over-producing have been so severe as to resemble police power enforcement devices in effectiveness.

In the year 1962 the penalty of 75% of the average market price for the preceding year for the particular kinds of tobacco had to be paid on tobacco marketed in excess of quotas (108). In the same year the penalty on excess wheat marketed was 45% of the parity price that year (109). These penalties provided strong economic incentives toward cooperation with

the programs in these cases. In the case of feed grain production, however, these grains could be raised and fed to livestock without penalty, and even sold without penalty at whatever price they would bring in the market. No corn loan was available to noncooperators in commercial corn-producing areas, however.

Legal Analysis of the Chryst-Timmons Plan - Constitutional Questions

As discussed in the economic analysis, the Chryst-Timmons plan purports to prevent the value of agricultural programs to farmers from becoming capitalized into land values, thus creating obstacles to the adjustment of both land and labor use within the total economy. The authors stated their belief that "no program can diffuse its benefits widely throughout the population if the instrument of control is of a permanent or semi-permanent nature and negotiable in the market" (15, p. 272).

The central feature of the plan would transfer the rights to market specified crops from land owners to a Government agency. The agency would subsequently sell certificates by bid authorizing the marketing of a specified quantity of a commodity. The certificates would be valid for one year only. The agency would sell certificates for marketing only that quantity of a commodity calculated to balance supply and demand at a target price.

Recognizing that the immediate execution of this plan would result in hardship to some land owners, the authors suggested that it might be desirable to work into the plan more slowly. They suggested legislation which would transform the rights of land owners to produce specified crops from property interests into personal rights, nonheritable, nonalienable, expiring after a period of non-use. Expiring rights would eventually result in a shrinking of production of affected crops to such an extent that an agency of the federal Government could sell rights to market commodities as suggested above. Thus, the plan would initially become established upon the present pattern of allotments rather than upon the basis of physically available land. The authors suggested further that the program could be accelerated by further limiting allotments at the outset so that rights to produce could be put up for bid early in the program.

The preceding discussion of the development of regulatory activities by Congress seems to support the conclusion that the Chryst-Timmons plan would not contravene the Tenth Amendment to the Constitution. The plan does not call for controlling any activity which has not been approved by the Court as a proper subject for regulation by Congress under the Commerce Powers. Furthermore it appears that the Court has no intention of invalidating legislation on the basis of issues raised by the Tenth Amendment. But the plan will come under close scrutiny from the standpoint of its impact upon

property rights. The authors point out that they have not explored the relationship of this program to institutions such as law and the political process. A discussion of some of these relationships therefore is in order.

First, it seems appropriate to state that the actual determination of the validity of law under our system must await future conflict and litigation from which arise decisions by the United States Supreme Court. From previous discussion the reader will deduce that there are two theories of the function of the Court relative to determinations of legislative validity. The first is that the Court will not pass upon the substance of legislation, but will look to the process of execution. This is one interpretation of the "due process" clauses of the Fifth and Fourteenth Amendments. The second theory is that the Court exercises its proper function by reviewing not only the means of execution of law but also substance of legislation. During the recent past the Court has showed no tendency to invalidate either acts of Congress or of state legislatures pertaining to property rights as contravening the Fifth Amendment, but at no time has the Court expressly relinquished its function of legislative review.

A hypothetical case would probably illustrate the constitutional questions arising out of the Chryst-Timmons plan to better advantage than merely a general discussion. Assume that farmer James Roe has owned and operated a cash-grain

farm in Western Kansas for many years. Until 1963 Roe maintained a 400 acre wheat base along with 200 acres annual fallow. During two representative post-war years Roe's accounts took on the appearance of Table 4.

Table 4. Summary of accounts from the James Roe farm

	1958	1962
Wheat harvested (acres)	400	400
Average yield (bushels)	23	23
Direct costs (dollars)	2960	3280
Overhead costs (dollars)	3690	4100
Price (dollars per bu.)	1.70	1.95
Net returns (dollars)	8990	10560

In 1963 Roe diverted 10 per cent of his wheat base to non-use, but government payments together with net returns from wheat production amounted to about the same income as in 1962.

Assume that during the 1963 session, before wheat planting time, Congress enacted legislation based on the Chryst-Timmons plan. This legislation transformed Roe's wheat base allotment into purely personal property, nonheritable, nonalienable, expiring after non-use. Assume further that Roe harvested his wheat during the summer of 1964 and realized approximately the

same net income as that to which he had become accustomed.

One of the features of this plan was high support prices which would enable incumbered land owners to realize expected income from the land for a time. Assume that before wheat planting time in 1964 Roe expired. Roe's executor then learned that the only profitable alternative use of the land permitted under the agricultural program was grass. A bulletin obtained from the extension service gave the following information on returns which might be expected from grass. (The data used in the calculations were from two western Kansas stations). The bulletin disclosed that a net income of \$2.56 per acre might be expected annually as an average over the first twelve years if the first seeding was successful. If a second seeding would be required the amount would fall to \$1.30. These income expectations are based upon beef at twenty cents per pound. If the first seeding were successful the 600 acres involved would net an average income during the first twelve years of \$1536, and only \$780 if two seedings were required.

After considering the value of the grass alternative Roe's executor decided to attempt to enter into litigation with the Secretary of Agriculture on the basis of a charge that the law making Roe's allotment nonheritable had deprived Roe's estate of property without due process of law. Without going into details of procedure it will be assumed that the case reached the docket of the Court in about the same way as the case Wickard v. Filburn (134). In that case Secretary

Wickard waived his immunity from litigation as a representative of the Department of Agriculture in order to simplify getting the case on the docket. The case of Wickard v. Filburn (134) was one of approximately thirty cases regarding the validity of the regulatory provisions of the 1938 Agriculture Act, among other questions. The case was selected because it represented an extreme application of the impact of the Act on local agricultural industry. Roe's executor authorized Roe's son, only devisee of the estate, to plant wheat in the fall of 1964, and the wheat was harvested in the summer of 1965. Roe's executor refused to pay the penalty on the wheat pending the outcome of the case.

Roe's executor would probably point out that the reduction of expected net income from the land, due to the Act, from the range of \$8000-\$10,000 down to the range of \$800-\$1500 annually would reduce the market value of the land by about the same proportion as the ratio of the two ranges of income. He would also compare the sale price of land of similar quality in grass against that with a large proportion in wheat, pointing out at the same time the expense and uncertainty involved in getting a good grass stand. Any variation of this analysis would point to the fact that the property had depreciated to a value less than one-third of its former value, before the enactment of the Chryst-Timmons plan. But would the Court hold that the property had been taken without due process of law? And if so, would the Court invalidate the Act or order

compensation? The first question will be discussed first.

In the case of Wickard v. Filburn the Court looked into the validity of charges that the regulatory provisions of the 1938 Agriculture Act took Filburn's property without due process of law. But it should be reiterated at this point that the economic situation at that time was not the same as the economic situation in the case Roe's executor has brought before the Court. In Wickard v. Filburn (134) the Court could point to the fact that the market price for wheat only a short time before the impact of the Agriculture Act had been only 32 cents per bushel. The value of Filburn's property without the program could be based upon 32 cent wheat. Roe's executor is basing the former value of Roe's estate on market prices for land during a period in which the price of wheat was in the range of \$1.70 per bushel to \$1.95 per bushel. It was not difficult for the Court to arrive at the holding that Mr. Filburn's property position could have hardly been made worse by the Act. In fact, it appears that the case would not have been considered by the Court apart from the question of the validity of the Act under the Tenth Amendment. At the time the Tenth Amendment question was the pressing question.

In Wickard v. Filburn the Court applied the principles arrived at in the case of U.S. v. Darby (125) to agricultural production in the most local sense. As stated previously, the Court cited no supporting cases discussing the Fifth Amendment question in the case of Wickard v. Filburn. But the

discussion did suggest some principles which should be of assistance in determining the probable outcome of the case Roe's executor has initiated. The writer is not trying to suggest that there are hidden principles of law buried in the case which are discoverable by anyone who will take the trouble to study the case long enough. But the principle suggested by the Court in Wickard v. Filburn may be found elsewhere in public law.

Throughout the opinion in Wickard v. Filburn (134) the Court compared the position of Filburn under the Act with his probable position without the Act. The norm upon which the Court based Filburn's economic position without the Act was the world market for wheat. But the important fact here is that the Court compared Filburn's economic position, relative to property, with the Act and without the Act. The outcome to the question in this case Roe's executor has brought up turns on whether or not the Court would still use the same technique in arriving at the holding.

Neither Congress nor the Court could logically arrive at the conclusion that the part of the Act making property in quotas nonalienable and nonheritable was separable from the remainder of the Act. The Act would be of little significance without this part. Roe's executor, then, is challenging the entire Act. So if the Court used the same technique as in Wickard v. Filburn the question would be, How does the value of Roe's estate under the Act compare with its

value without the Act. In this case "without the Act" would mean without any act pertaining to wheat production.

It would not be realistic to assume that Congress would make the mistake of offering loans on feed-grains for which wheat is a good substitute in livestock feeds while not regulating wheat production. If feed-grain prices were supported, these supports would establish a floor under wheat prices as farmers sold crops to the Commodity Credit Corporation and then purchased wheat for livestock feed. If wheat prices sank far below supported prices for feed-grains other than wheat, the C.C.C. would accumulate unreasonable quantities of the feed-grains which farmers would raise as a cash crop, while purchasing or growing unregulated wheat for a feed crop. One is led to believe in this case that the Court would use a free market situation for wheat and all feed-grains for which it is a good substitute as a norm for determining the value of Roe's estate without the Act. What would the price of wheat be under this free market situation? Arnold Paulsen and Don Kaldor have made such estimates, and these estimates should be fairly typical of estimates which would be considered by the Court (70). The study assumed that most price supporting operations would cease, government holdings of commodities would not be dumped on the domestic market, and the barter and soft currency provisions of P.L. 480 would continue. The study projected prices for the three year period 1960-1963, and the 1962 estimate of the wheat price

was an average of 74 cents per bushel (70).

What would be the value of the Roe estate with 74 cent wheat and other feed-grains at comparable levels? Assuming that costs on the Roe estate were similar to those of 1962, the estate would lose over \$500 on the same scale of wheat production. The next step is to compare this \$500 loss with the \$800-\$1500 expected net income from grass under the program of regulation being attacked. This expected income from grass assumes that the value of the beef grazing the grass would remain in the range around 20 cents per pound. This would be possible under the program of regulation, because the program would continue to support the prices and probably control the quantities of feed-grains. In other words, according to these assumptions and calculations, the value of the land for agricultural purposes would be greater under the Chryst-Timmons type regulation than with no controls on output or supports for prices for wheat or other feed-grains. The central point on which this turns is whether or not the Court would use the same technique in determining the impact of the Act upon the value of Roe's estate as used in Wickard v. Filburn (134). Would the Court compare the value of the estate with and without the Act being challenged. Other results would be obtained if the Court compared the value of Roe's estate under the act being challenged with its value under some other Agricultural Act or succession of Acts of past periods. Other results would also be obtained by applying

the same technique to a situation in which an agency of the federal Government "took" the same property, the Roe estate, for purposes of a flood control project, for example. The technique would be the same but the results would be different from those arising out of challenging the Agricultural Act. The question would be, what would be the value of the Roe estate before and after the lake? In this case the value norm would include the capitalized value of agricultural programs, or expected value from future programs. In effect this question would resolve into the question, what would be the value of the Roe estate with and without the Act authorizing the taking of the land for the lake? This would be true even though the Act itself in this case would not be challenged.

Agricultural Acts of Congress usually do not constitute a continuum. There might be a discrete break between the acts amounting to a number of days, months or even years, or there may be no discrete break at all. But the value accumulated by an estate under one Agricultural Act probably cannot claim as a vested interest to be carried on under another act. One may therefore consider that there is either an indiscrete or a discrete point between two Agricultural Acts, during which period one act is dead and there is no act at all. This is a matter of logic and only used to illustrate the legal principle that a vested right probably would not arise out of an Agricultural Act. Two recent cases

in lower courts have reiterated that principle (95 and 30).

It is obvious that Congress is free to eliminate all agricultural programs, phase out the Commodity Credit Corporation as the Farm Mortgage Corporation was phased out, eliminate school lunch programs by federal Government and repeal Public Law 480. Must Congress actually do this and allow land prices to be set in such a market before a free market norm can be used to compare the value of property under an act of Congress? This writer does not believe that Constitutional Law would require such an action.

It is possible that Roe's executor would charge that the effects of the regulation were discriminatory. He could point out that basing the durable qualities of production rights upon longevity of life of an individual was discriminatory, imposing a severe handicap upon the estate whose present owner's longevity was short, as in the case of Roe. He could point out that estates held by corporations would not be affected in the same manner. But Government counsel could point out that the Court in Mulford v. Smith stated that it was not concerned with the fairness of the regulations as long as the regulations stood the test of the Fifth Amendment (63).

Congress would probably include in the legislation provisions for ameliorating the severe hardship of classes of farmers in an unfavorable position under the act. In presenting their plan for resource allocation, Chryst and Timmons

pointed out that they were submitting it to the economics profession for study and discussion rather than as a plan for immediate legislation. This would indicate that the authors meant merely to set forth some principles of regulation which could become a foundation for a program of effective adjustment. It is probable that the plan would be used only in cases in which the differential between land values based on commodities supported by programs and land values based on the next highest use for the land is unreasonably great.

There are a number of variants of the plan which could utilize the agency sale of production rights by bid. This principle of selling the right to participate in the benefits of certain marketing advantages obtainable only from government has been suggested before. R. H. Coase has recommended that the system be used to allocate rights to use radio frequencies (17). He stated the belief that competition for rights to use these resources would add market discipline to the process of administrative allocation of rights to use public resources of value to private firms. In this case the resource is a part of the public domain, but the comparison seems justified, because a substantial part of the value of agricultural services of land is attributable directly to Government price supporting operations and as such might be considered as a public phenomenon. In either the Chryst-Timmons plan or the Coase plan the funds accruing from such sales would become available for public use. In each case the funds would be used

to improve the quality of service, magnitude of services and variety of services from the basic resources involved.

Many variations of the Chryst-Timmons plan are possible. One variant might reduce all marketing rights for a particular crop by the same proportion over a period of time until a suitably large reservoir of rights were available for sale by the agency. If a farmer wishing to expand production had available two alternatives--the purchase of land with a few rights attached, or the purchase of the rights to use more of the land he possessed for more profitable purposes--he would probably not pay more for the rights attached to land than for the rights available from the agency. If he were uncertain about future income from farming he might prefer to acquire the rights from the agency for one year at a time rather than risk eventual loss of rights presently attached to the land after he had paid dearly for them. Furthermore, if farmers were certain that present rights attached to land would be reduced by some percentage each year, this knowledge might inhibit them from bidding up land values in order to obtain their marketing rights. After this same technique, marketing rights might be reduced proportionately to a point at which annual production would allow the disposal of stored grains considered as surplus, then a few rights would become available for agency sale by bid. The treatment of this plan in the political crucible would surely alter it, to moderate its impact upon property rights, and the resulting legislation

would probably meet all constitutional requirements.

One outstanding feature of the Chryst-Timmons plan is that it would create no vested interests of consequence, so would therefore present no constitutional problems at the time of its repeal, after sufficient adjustment in resource use and valuation had taken place. This is of no small importance to the freedom of Congress, or the willingness of Congress, to deal with problems in allocation of resource use and distribution of income. The plan does not purport to eliminate property in land, but it does purport to remove property in land as an obstacle to continuing flexibility of adjustment of land and labor resources. The conclusion here is that the Courts would probably not stand in the way of the effective implementation of the plan by Congress.

Limiting Production by Government-Producer Contract

In the 1956 Agricultural Act Congress included a provision for nearly complete restriction of land use through a voluntary plan involving compensation. The common name for the program is the Soil Bank Program. The framers of the Act attempted to avoid involvement in common law property institutions insofar as it was possible. It is interesting to note the extremes to which the drafters went in order to skirt around these institutions. One would be inclined to think that the restriction of land use under these direct payment circumstances would involve the transfer of some kind of property interest such as a lease

or an easement for a term of years. But Congress imposed its restrictions by means of personal contracts with farm operators.

The contract used under the Soil Bank Program to bring about land use restriction provides an example of a hybrid derived in part from property law concepts and, in part from contract law and in part from experimental legislative and administrative innovation. Technically it was a personal agreement between the Secretary of Agriculture and a farm operator. Operator was defined merely as one having control of the farm during the contract period. Operators shared in the responsibilities and benefits roughly in proportion to their degree of control, theoretically at least. The basic provisions of the contract were set out in the Act, and the Department of Agriculture filled in the details and enforced the contract. The County Agricultural Conservation and Stabilization Committees acted as agents of the Secretary of Agriculture at the lowest level. Disputes over fact were decided by the State committee, and its decisions were final unless determined by a court of competent jurisdiction to be in bad faith. This seems to be standard administrative procedure (Contract CSS-861 18-7-59).

The original Soil Bank Program of 1956 contained two provisions designed to make the personal contract run out its term in the event of transfer of an interest in the land to which it pertained. Common law property interests, such as

the lease or easement, would, of course, run out their terms unaffected by the transfer of the fee title to the land. But Congress devised a means of assuring that most of these purely personal contracts would run to restrict the new owner of the land. This was accomplished by two provisions in the contract: (1) The purchaser of land under contract could become a party to the terms of the original contract, under a new contract, and (2) A provision was placed in the contract whereby the original contracting producer (the vendor) would have to refund all cost-share payments he had received under the contract if the contract were not taken up by his grantee. These cost-share payments were made to assist the farm operator in getting the type cover on the land required by the contract. These payments would amount to relatively large sums when the operator seeded his land with a permanent pasture grass.

This unique impetus to the running of the contract had some unexpected results in some regions. The annual Soil Bank Program payments constituted a low-risk, fixed-return income from investment in land which apparently became attractive to more non-farm investors than Congress could tolerate, because Congress took action in 1958 to devise an arrangement which would not "run with the land" so easily. If land retirement had been the only objective, this passing of land into the hands of investors would not have been disturbing, but the payments constituted one more means of supplementing farm income. The 1958 Act corrected this deficiency in part by

requiring that new and subsequent contracts could not be taken up by the purchaser of the land under contract (the vendee) for twelve months after purchase unless the county committee determined that the farm would have continued to be farmed by the new owner in the absence of the Soil Bank Program, which was a rather difficult decision for county committees in some cases.

The 1960 Act provided that the contract could be picked up by the purchaser of the interest in the land under contract if the land had been under conservation reserve contract for at least three years prior to sale. Taking up the contract was actually a recontracting process between the new owner of the interest in land and the County Committee, for the contracts were purely personal. After the contract had been in effect three years, the vendor was not subject to penalty.

This regulation of land use through personal contracts seems to provide considerable flexibility, but potentially at unreasonable cost to the public. A property interest could accomplish the same regulatory objectives while vesting in the federal Government an interest of value which could be sold or leased subject to appropriate restrictions in the deed passing the interest to the Government. If public cost were no restraint, the personal contract would be an ideal means of land-use regulation. Contracts could be of short duration and subsequent contracts could reflect the immediate will of Congress as changing economic conditions, technologies,

and social pressures dictated. Since the contracting process would be voluntary, problems of a constitutional nature could probably be successfully avoided.

Controlling Land Use Through Government Purchase of Perpetual Property Interests

As discussed previously, perpetual property interests, such as easements, would have certain advantages over short term arrangements for restricting land use. It therefore seems appropriate to look into the technical aspects of cropping easements as applied to public control of land use. The more complete interests will not be discussed because Government ownership of agricultural land on a wide scale seems a remote possibility in the United States. A look at the results of Government ownership of western grazing lands will reveal that public ownership of land does not solve all problems of allocation of use rights, although public ownership has many merits in some regions.

Herbert Thorndike Tiffany begins his treatise on easements with the following definition: "An easement involves primarily the privilege of doing a certain class of act on or to the detriment of another's land, or the right against another that he refrain from doing a certain class of act on or in connection with his own land, the holder of the easement having, as an integral part thereof, rights against the members of the community generally that they shall not interfere with the

exercise or enjoyment of the easement" (100, p. 1198).

An easement in the traditional sense involves two estates, the dominant estate and the servient estate. The benefit accrues to the owner of the dominant estate, with the burden being attached to the servient estate. Both the benefits and burdens run with the respective properties to which they are attached to affect subsequent owners. As long as the easement continues in existence its benefits and obligations will pass to grantees, devisees or heirs of the estates.

Obviously, the federal Government doesn't own estates adjacent or near all the land which might need to be restricted. But there is an easement in gross recognized at law in some states. The benefit of the easement in gross is held without respect to any dominant estate. In a few states the courts have refused to allow the benefits of some types of easements in gross to be assigned to another by the original holder of the benefit, or to pass to devisees or heirs. This area of law is perhaps one of the most confused in all common law. This refusal of courts in some states to allow the assignment of the benefits to easements in gross, in some instances, might lead some to believe that such an interest in favor of the federal Government would not be recognized in those states. There is evidence, however, that all states have regularly enforced easement-type interests in gross as property interests in cases in which the interest involved was of considerable value. Gerald E. Welsh has pointed out

that much of the confusion introduced into the realm of law dealing with the assignability of easements in gross has been due to the fact that courts have almost invariably stated the standard rule against assignability and then proceeded to create exceptions so as not to follow the alleged rule which, he asserts, should have been renounced and forgotten long ago (133). Mr. Welsh conducted extensive research and claimed to find only ten cases which he insists are the only American cases he has been able to find supporting the alleged rule of nonassignability, notwithstanding numerous statements in dicta (133, p. 278). All these cases were concerned with rights in alleys or other ways for which there was no real necessity. In addition Welsh listed eight cases which are frequently used to support a statement of the alleged rule, but he insists that these cases were decided on the intention of the parties to convey a mere personal, and therefore, non-assignable right (133, p. 278).

Charles Clark, former circuit court judge, believes that the reason why some courts have hesitated to allow the benefits held in gross to run as property interests when they are of small value is that such easements constitute incumbrances to titles to land which should be removed before land titles are transferred. An old legal easement of little value to heirs of the benefit scattered over the country could become a serious obstacle to certain uses of the burdened land at a later date. In addition, the cost of clearing titles of these

incumbrances is often very great, due mainly to the fact that heirs of the interest held in gross must often be hunted throughout the country. Experience has showed that holders of property interests of considerable value are not as difficult to locate as those holding interests of so little value as to escape the memory (16, pp. 83-89).

When the benefit to the easement in gross is held by a corporation, private or public, these objections are no longer pertinent. Firstly, the interest acquired is usually of considerable value. Secondly, a government or a public utility corporation simply does not fade away into the populace. They are not difficult to locate in case of questions over rights and responsibilities or of property transfers. Thirdly, the instrument assigning rights and responsibilities (the deed) is usually professionally created with some degree of skill and forethought when the benefit is held by a government or a corporation. Fourthly, Mr. Welsh and Mr. Fratcher, law professor of Michigan University, suggest that with our doctrine of constructive notice, it is practicable to permit the imposition of many types of encumbrances on realty which, in the absence of such acts, would have been a source of confusion and inconvenience.

Professor Vance of Yale University argued that courts had often refused to allow assignability of the benefit of an easement in gross because the easement in gross, not being

related in its enjoyment to any dominant estate, is without limit except for the terms of the grant (130). This would not be a problem of significance in respect to an easement in gross whose benefit was held by the federal Government because the terms of the arrangement would be carefully spelled out in the deed of grant. This would be carefully and skillfully created, but would not mean that there would never be misunderstanding at a later date as to the interpretation of the terms, but old common law rules of construction would probably be of little help in this case.

One possible problem remains, in respect to acquisition of cropping easements by the federal Government. That is the problem of interpretation of the nature of the easement, whether affirmative or negative. Most legal easements today are affirmative in nature; that is, the owner of the benefit has the right to some affirmative action in respect to the servient estate rather than the right to restrict the servient estate in some manner. There is a class of negative easements which has largely been replaced by other types of interests. The American Law of Property states that the doctrine of negative easements has never been extended beyond the four types recognized by the early English cases; light and air, support of a building laterally or subadjacently, and flow of artificial streams (59, p. 402). Unless the desired restrictions fall within one of these types, they are not enforceable as negative easements. The probable reason for

the lack of development of this doctrine was a rigidity in the doctrine during a long enough period of time that other arrangements were designed to restrict the use of property in the desired manner. Today legal and equitable covenants or servitudes carry out the restrictive function.

In looking to the future, one cannot discount the possibility of the enforcement of new type of negative easement by the courts. On the other hand, a very technical legal mind might fear that the courts would interpret cropping easements as imposing some kind of an equitable restriction on the land. One of the properties of an equitable restriction is that, after the purpose under which an equitable property interest is acquired no longer exists, the rights may be terminated by the courts. This power of the courts to clear titles in cases in which the incumbrance no longer has meaning has been of great value in property law (75). If Congress desired only to impose a negative restriction this could probably be accomplished at law by having the land owner assign the title to the Government, then the Government agency would restrict the title by a legal servitude and deed the property back to the land owner. This is but a single transaction and not uncommon in property law. This restriction in a deed would not provide for maximum flexibility of control, however.

John F. Timmons has pointed out that considerable flexibility of control of land use at minimum cost to the public,

wherein farmers were paid to reduce production anyway, would be provided by a legal positive easement¹. In this case the Government agency would purchase a permanent property interest which could be leased to the appropriate farm operator in the event the public interest called for resumed intensive production on the servient estate. There would be no reason why the Government could not lease the interest to the farm operator for one dollar and his appreciation if, under the circumstances arising at any particular time, Congress did not wish to take the property owner's money. But the interest would make possible the leasing or selling of the cropping right, if Congress ever deemed this appropriate.

The time may come when an income transfer from the farm sector to the non-farm sector is desired in certain instances. These points have been discussed in the previous chapter in more detail. The appropriate restrictions covering the assignment of the interest could be placed in the deed granting the interest to the Government agency. Ample arrangements could thus be made for permitting the assignment of the interest only to the owner of the fee title to the servient estate, if this were desired. This feature would be necessary to prevent possible conflicting rights to use the servient estate. Nearly any combination of restrictions could attach

¹Timmons, John F. Department of Economics and Sociology, Iowa State University of Science and Technology. Easements for regulating supply. Private communication. 1959.

to the Government's interest in the servient estate, and virtually any type of cropping right which the Government might wish to obtain would be possible through this positive easement in gross. Considerable flexibility of design is possible here.

One important feature of permanent property interests is that such interests would allow Congress to work out land-use patterns in certain areas if this seemed desirable. This would probably necessitate the use of the power of eminent domain. An attempt to apply a uniform pattern of land use in an area by means of the acquisition of property interests would invariably encounter a few noncooperative property owners.

Use of the Power of Eminent Domain by Congress

Edward S. Corwin states that before the Civil War it was generally denied that the National Government could exercise the power of eminent domain within a state without the consent of the state (25, p. 221). This concept came directly from the Constitution. Article I, Section VIII, Part 17 of the United States Constitution reads, "Congress shall have the power to exercise authority over all places purchased by consent of the legislature of the State in which the same shall be, for the erection of forts, magazines, arsenals, dockyards, and other needful buildings".

This part of the Constitution has not been interpreted as

preventing the federal Government from exercising the powers of eminent domain without consent of the state in which the property is located since the Civil War. An old leading case in this area of law is U.S. v. Gettysburg Electric Ry. Co. (126). The central question was whether or not the acquisition of land for a monument to the Battle of Gettysburg by the federal Government constituted a "public purpose" sufficient to authorize the use of the powers of eminent domain. The Court held that the purpose did constitute a "public purpose" and went on to define the authority of Congress to exercise the power of eminent domain generally in an opinion which could aptly be classed as a stirring piece of literature. Mr. Justice Peckham delivered the opinion and stated, "(T)he government of the United States is authorized to condemn land whenever it is necessary or appropriate to use the land in the execution of any of the powers granted to it by the Constitution" (126, p. 679). He stated further that any combination of powers would serve the purpose of authorization, that no one specific power needed to be designated.

U.S. v. Gettysburg Electric Ry. Co. has been followed through the years, and a recent case in point is T.V.A. v. Welch (103) in which the court stated, "We think that it is a function of Congress to decide what type of taking is for a public use and that the agency authorized to do the taking may do so to the full extent of its statutory authority" (103, p. 552). The question involved the authority of the

T.V.A. to condemn an area of privately held land made inaccessible by a reservoir, because it was decided that the land could be purchased for less than the cost of building a road to the area. The area was purchased and turned into a national park.

The Court pointed out that there was confusion over the difference between the attitude of the Court toward the question of "public purpose" in the case of condemnation proceedings executed by local governments and corporations vested with the power on one hand and the attitude of the Court toward the power of Congress to exercise the power of eminent domain on the other hand. In the former case common law rules of construction are usually construed quite narrowly in favor of rights of property owners. In the case of the exercise of the power by Congress the common law rules are not applicable, and the statute is liberally construed. The Court made the following definitive statement (103, p. 552):

(W)hatever may be the scope of the judicial power to determine what is a "public use" in Fourteenth Amendment controversies, this Court has said that when Congress has spoken on the subject "its decision is entitled to deference until it is shown to involve an impossibility. (Old Dominion Co. v. U.S., 269 U.S. 55, 66) Any departure from this judicial restraint would result in courts invalidating legislation on the basis of their view on that question at the moment of decision, a practice which has proved impracticable in other fields.

Thus it can be concluded that the discussion of the wisdom of using eminent domain powers to secure cropping easements of various kinds, or merely land-use easements,

belongs in the policy arena rather in the arena of Constitutional Law. And the discussion of the wisdom of using easements to direct land use in difficult cases belongs likewise in the policy arena rather than in the arena of common law.

Legal Analysis of Saleable Production Rights--Private Sale

Some economic aspects of the plan for private sale of separated production quotas has been discussed in Chapter 3. One of the last definitive discussions of the plan appeared in a paper by Phillip M. Raup and Elmer Learn (78). In the paper the authors suggested some economic aspects, then went on to point out some of the legal problems which the execution of such a plan might create. It was suggested that saleable marketing rights would necessitate a reorganization of the property tax institution. The property tax institution is presently in the midst of a general reorganization in most states. A system of registration would need to be worked out for the marketing certificates representing the separated marketing rights. The authors suggested that it would probably be advantageous to set up a certificate transaction recording system in the office of the register of deeds in each county, parallel to the records of title. The alternative would be a commodity exchange. The authors pointed out that registration of marketing rights, or certificates, parallel to title records would probably result in a minimum disruption in the traditional system of local public finance. This means would also

result in a minimum of additional institutional structure which would have to come down in the event the program were to be abandoned at some future time.

The separation of rights to produce certain commodities, probably most of the grains, from the rights inherent in the fee title to land should present no constitutional difficulties, since property owners would be deprived of nothing. They would merely be able to market a portion of their property rights which had previously been negotiable only as an integral part of the land. A part of the separated rights would consist of the value of regulatory services of the Government. The execution of this plan would presumably make the value of these public services a permanent part of private property, even though chattel instead of real. Congress could reduce the quantity represented by each certificate by a certain proportion. The regulatory powers of Congress may reach chattel property as well as real property. These rights would not escape regulation because the type of property had changed.

Upon only brief consideration of this plan, it appears that there would be no way to terminate it at some future time without completely wiping out these property interests, but further reflection will reveal that the rights could be systematically rejoined with residual land use rights. That part of the rejoining operation concerning land owners holding rights could be virtually automatic. The rights could simply

be rejoined with the residual rights by act of Congress. In cases in which tenants or others owned the rights, these individuals could be given a reasonable period of time to sell their rights to some land owner. To assure that land owners did not hold out on owners of these rights until near the deadline, hoping to purchase them for a small consideration, an agency of the Government could guarantee tenant certificate holders some minimum price which would be low enough to prevent large sales to the agency, but high enough to forestall a holding action by land owners against tenant certificate-holders. But it would be very difficult to pass into an unregulated marketing system.

In the event a central certificate market were established, this would probably represent a powerful vested interest opposing the abolition of the program. It would be analogous to eliminating a major stock exchange in one stroke. On the other hand the thousands of local register of deeds offices would conceivably establish nothing of value in this connection. County governments would probably be ready enough to go back to registering only deeds to real property. The suggestion by Baup and Learn that the certificates be handled in a system parallel to the property registration system has merit. Local taxation would also be simplified by local registry.

Due to an expanding population the aggregate quantity of each commodity would not often have to be reduced, since the

certificates would represent bushels instead of acres. But foreign markets could be lost either temporarily or permanently making it necessary to reduce supplies marketed. Of course the C.C.C. could purchase surplus commodities, thereby holding up commodity prices, but the more economical way would prevent the resources from being combined into commodities. An interesting system for accomplishing this would combine regulation by Congress under its Commerce Powers, some features of the privately saleable market certificate plan, and the agency certificate sale plan by Chryst and Timmons. When agricultural economists determined that a decrease in demand for a particular commodity was a long-run phenomenon, Congress could reduce the quantity represented by each certificate by some proportion. When a reduction in demand was deemed to be a temporary phenomenon, an agency could either purchase certificates in the open market, selling them again after demand for the particular commodity had picked up again, or reduce certificate value as above.

If agricultural economists were to determine that an increase of either long or short run demand was in the making, the agency certificate plan suggested by Chryst and Timmons could be called into use. The agency could create and sell by bid enough certificates, good for one crop year, to bring supply and demand into a relationship calculated to result in a desired target price. Congress could provide that the agency could create the more durable privately saleable

certificates to cover long run needs, but this would result in needless capitalization of expected future income from certificates, and thus reduce the regulatory value of the system. The one-year certificate plan would be of very great value to Congress as a regulatory function. Receipts could be used in a variety of ways directly connected with the problems of the agricultural sector in general or in relation to the specific commodity from which the receipts accrued. Congress would have to determine the use to be made of the receipts.

If the privately saleable marketing certificates were to be created by Congress, it would facilitate the ease and effectiveness of regulation of supply if Congress would first reduce marketing quotas to correspond to estimated long run supply and demand relationships at desired commodity prices, plus a further reduction to allow clearance of surplus stocks of agricultural commodities. Then the agency sale feature could be called into use to supplement the durable certificate program. A wide range of combinations is possible when a significant portion of the rights to produce and market commodities do not get into the privately held long-term or perpetual property interest category.

Returning to Market Regulation of Supply

Congress obviously has the power to remove all supply regulation by Government from agriculture, or Congress could

gradually reduce loan rates on commodities until the programs rationing rights to produce or market would have no economic significance to a large part of the agricultural industry. This action would probably create as many obstacles to adjustment of land and labor resources as it removed, although this is a matter of speculation. Maximization of societal returns from land and labor would still require financial and institutional assistance of a public nature. But there would be no Constitutional problems involved in removing regulation from agriculture.

In summary, the conclusion is reached that the United States Constitution does not stand as an obstacle to a wide range of effective means of agricultural adjustment. The Courts have expressly defined the power of Congress broadly enough to accommodate the creation and implementation of effective adjustment institutions including those discussed in this paper. Regulatory powers of Congress under the Commerce Clause might profitably need to be accompanied by the exercise of spending powers, proprietary powers, powers of eminent domain, and perhaps eventually the treaty powers. The power of Congress to regulate commodities in respect to which it enters into treaties with foreign nations has hardly been explored. The power of Congress to regulate interstate and foreign commerce has proved adequate so far. We would indeed be the most pitiable of all nations if our Constitution proved to be a major obstacle to economic and human develop-

ment. But the great moving trends of Constitutional Law reveal no such obstacle.

There appears to be no obstacle preventing the federal government from using common law property interests as a means for regulating land use. No valid reason for federal government avoidance of property interests in agricultural programs exists.

One paramount point which this chapter should illustrate is that certain impacts of "pure" principles of adjustment upon traditional institutions can be moderated by mixing legal techniques. This mixing need not destroy the adjustment powers of legislation based upon any good adjustment model.

A discussion of the power of Congress shorn from social and psychological considerations sounds "harsh". One characteristic of effective government is great power used with restraint. Economic researchers need not fear that Congress does not have sufficient power to implement an adequate adjustment model.

SUMMARY AND CONCLUSIONS

The problem of imbalances between supply of and demand for agricultural products as considered in this report, arises in part out of expectations of increasing flows of new agricultural production technologies throughout the foreseeable future. An increasing tempo of basic research activities seems inevitable, and increasing rates of technological development and adaptation to production seem highly probable. Also, the institutional structure which has evolved over past decades reflects the failure of policy makers to take sufficient cognizance of the varied impacts of technologies, the many routes by which technologies reach agricultural production functions, and the nature of the factors generating technological evolution at increasing rates. The institutional structure of agriculture seems inadequate for accommodating agricultural change without transgressing widely accepted welfare principles or inhibiting economic development.

The dissertation has for its foundation four hypotheses: (1) limitation of technological evolution in general is not a feasible means of limiting agricultural supply in the United States; (2) supply regulating institutions must therefore limit agricultural production to desired aggregate levels; (3) technologies are differential factors in respect to their impact upon farm firms; and (4) the existing framework of legal concepts which constitute United States law is adequate

for developing and implementing effective agricultural programs.

The purposes of the study are (1) to examine the origin and development of certain technologies affecting agricultural development, (2) to analyze the differential nature of technologies and consider implications, (3) to appraise certain existing and proposed agricultural programs, (4) to suggest reorientation of agricultural programs to accommodate technological development and (5) to examine the adequacy of the existing framework of legal concepts for implementing suggested agricultural programs.

Limitation of technological discovery and development is not a feasible means of regulating aggregate agricultural supply because such limitation would inhibit progress toward paramount personal and societal goals. A continuing and increasing flow of basic discovery is inevitable in modern societies largely because of the exploratory curiosity of a few individuals. These individuals are frequently motivated not only by curiosity, but also by satisfaction derived from reporting and discussing findings, by altruism or by economic incentives.

Modern societies have established institutions which depend upon the continuing growth of basic research and technological development. Educational institutions have integrated pedagogy and basic research in the sciences into their structures. Modern warfare has come to depend increasingly

upon technological discovery and development. Commercial competition depends increasingly upon new product development and product improvement through research and technological development. The age-old fear of resource depletion continues to motivate societies to develop and maintain contingency reserves of technologies, resources and commodities, even in the presence of a growing excess agricultural capacity. Progress toward these goals contributes in manifold ways to an increasing food production capacity.

Because of the many sources of new technologies affecting agriculture, precise control of the development of technologies adaptable to agricultural production or food production would not be feasible. But it should be possible to develop technologies which would enable the traditional agricultural resources, land and labor, to compete more favorably with new factors which would substitute for them. Since technologies are differential factors in their impact upon agricultural production, it should be possible to tailor technologies to different recurring types of agricultural demand in the United States. Technologies might be tailored to specific situations found in the various developing nations.

Policy makers could improve agricultural legislation by taking cognizance of the manifold sources of new agricultural and food production technologies which both make agricultural land and labor more productive and substitute for land and labor in producing some given quantity of food. Past agri-

cultural programs have stabilized income from agricultural investments at levels which make land use shifts at extensive-intensive margins difficult to achieve without transgressing widely accepted welfare principles. The institutional structure which has developed over the past three decades may have achieved a measure of income stability in agriculture at the cost of inhibiting land use shifts.

An investigation of Constitutional law and common law as they exist and as they evolved over time leads to the conclusion that there is a wealth of legal concepts which may be used to develop and implement such program features as those discussed in this report. The limiting factors seem to be a lack of proficiency in their use and a lack of will to use existing legal concepts effectively.

After an examination of the origin and development of a number of agricultural technologies it is concluded that the scientific revolution has been generated basically by personal motives. A small number of men, following courses suggested by curious intellects, have discovered relationships between and among components of nature and from this basic knowledge have learned to manipulate and regroup components, altering natural conversion processes. Early scientists were generally poorly treated by their contemporaries, but scientific inquiry was eventually accepted as a legitimate profession. By the beginning of the 18th century basic research and teaching in the physical and biological sciences became a function of the

university system.

The motives generating basic research have become more difficult to differentiate, but curiosity remains a primary motive. Professional status, and satisfaction from reporting and discussing findings among colleagues also appear to be important motives, as evidenced by the proliferation of scientific journals. Altruism appears occasionally as a strong motive and is probably an important factor more often than observed. Since competent scientists and basic developmental engineers presently are paid reasonably well, economic incentive could be an important motive underlying basic research today. These personal motives, among others, function to make a continuing flow of basic discovery inevitable.

Several case studies of technological development lead to the conclusion that a number of societal goals of high order have provided generating forces resulting in development and rapid adaptation of technologies. Three wars have stepped up the tempo of agricultural mechanization in the United States due in part to the shortage of farm labor during wars, but farmers have not returned to previous technologies following the wars.

Some technologies developed initially for war are adaptable to basic research in food component synthesis, plant and animal physiology and nutrition and fertilizer technology, for example. Development of inorganic fertilizers, insecticides, radioisotopes of nutritional elements and some mechanical

systems, among many other developments, have been applied to agricultural technologies.

The use of technological discovery and development by industry as a competitive weapon further supports technological evolution. Domestic economic development based on product development has taken on the nature of a national goal. During 1963 an industry average of 12 per cent of sales will come from new products (79, p. 23). Firms supplying agriculture with production factors press farmers to adapt new factors to production. Private industry is assisted by university experiment stations in developing technologies adaptable to agriculture, and the experiment stations have historically carried out the greater part of the adaptation research.

In 1862 Congress passed the first of a long series of acts leading to the establishment of agricultural colleges, experiment stations and extension services. In 1917 Congress provided for vocational agriculture in high schools. Out of this system of research and education a continuous flow of new technologies has been developed and adapted to agricultural production. Experiment stations have been the primary source of plant and animal culture and breeding technologies in the United States, in addition to functions discussed above.

Education itself is a concomitant of technology and is continuously improved in function and expanded in scope. In graduate colleges students learn to discover and develop technologies by studying and participating in research

activities.

By making progress toward war-potential goals, economic development goals and educational goals, society sets evolutionary forces in motion which function to bring about basic changes in the means of subsistence. In the process agriculture changes and develops excess capacity as machines perform more functions and as nonagricultural industry furnishes more agricultural resources.

A trend of immediate importance in food production technology is moving toward the development of conversion processes which render plant nutritional substances comparable to animal products in texture, flavor, color and nutritional composition. A long run trend is moving toward conversion of relatively abundant chemical compounds directly into nutritional components.

Case studies of the evolution and adaptation of technologies to food production lead to the conclusion that food production technologies are differential factors in regards to their impact upon the three basic relationships in agricultural production--factor-factor, factor-product, and product-product.

Product-product relationships involve problems of acceptance of new or improved sources of nutrition, or less costly sources of nutrition. In economics this involves indifference studies. Since color, flavor and texture technologies are developing at a rapid pace, acceptance

problems will probably be minimized in the future.

In regards to the varied impacts of different technologies upon agricultural production, the factor-factor relationship is of more immediate interest in the discussion of the differential nature of technologies. Planners in underdeveloped countries and in mature countries might desire to exert a measured and controlled impact upon certain existing agricultural resources with severely circumscribed alternative employment opportunities. In underdeveloped countries it appears possible to introduce technologies which will result in the release of labor from agricultural production at some desired rate corresponding to alternative employment training or retraining opportunities. In mature economies such control is much more difficult because of the availability of new technological inputs from many sources, and because of the institutional pressures upon farm operators leading to adaptation of new factors of production which substitute for land and labor in producing a given output. But it may prove profitable to place greater emphasis upon development of primarily cost reducing technologies which make possible a relatively greater return to agricultural labor out of some fixed gross income. These technologies should prove attractive to farmers with long term resource commitments and limited employment opportunities. Related technologies might make possible a more complete use of our natural resource base so that land will not be released from agricultural production

before valuable alternative uses have been devised.

Past agricultural programs have resulted in the release of land and labor from agricultural production at a more rapid rate than agricultural and nonagricultural institutions could accommodate. Rural educational institutions have offered little opportunity for nonagricultural training, and land has been retired under programs before valuable alternative uses have been devised.

A growing excess agricultural capacity to produce, accompanied by underemployed labor and land factors, has resulted in unsatisfactory returns to farming, in general. Agricultural programs which continue to peg prices at levels higher than equilibrium levels are being criticized for channeling program benefits into land values, thus inhibiting long run agricultural income improvement and further reducing mobility of both land and labor into alternative uses. If future agricultural programs cause the farm operator to view a fixed gross income arising from a given production period, then it appears that greater emphasis upon cost reducing technologies might become appropriate. Primarily cost reducing technologies would also be appropriate if prices were to return to market equilibrium levels, even though supported at those levels. Since the long-run trend moves toward an increasing production capacity, it would seem appropriate to reemphasize the need for developing long run cost reducing technologies adaptable to agricultural production.

Two agricultural programs have been suggested for removing obstacles to land use shifts and making land more competitive with new technological substitutes. Either program would remove the principal obstacles to changes in land use leading to more efficient allocation of production. One program would make marketing rights privately negotiable. The other would cause rights to revert to a government agency. The agency would sell one-year marketing certificates to farmers by bid, in the latter case, and thereby prevent benefits from being capitalized into either land values or privately held certificate values.

Long term certificates would create an obstacle to change of programs even greater than inflated land values. In the case of land, a residual land value remains after cancellation of price supporting programs. Cancellation of price supporting programs would leave certificate holders with nothing of value. The short term certificate program would facilitate movement toward equilibrium prices, but initial implementation of the program would be more difficult. The agency sale of certificates would make a reservoir of rural institution development funds available. This might encourage the implementation of development which would not otherwise take place. Programs supporting prices at high levels would be improved by the incorporation of the short term certificate sale as a means for allocating even a fraction of aggregate production rights.

Either program based upon separation of marketing rights

would probably be interpreted by the Supreme Court as being in accord with Constitutional law. The agency sale program would surely be challenged, but probably not successfully. The Court would probably estimate the value of agricultural land without price or income supporting programs and use that estimate as a norm for determining the impact of programs being challenged.

Common law easements would probably be superior to contracts for regulating land use through voluntary methods. The use of perpetual easements would eliminate recontracting problems arising out of expectations of future intensive use of the land after expiration of contracts. Easements would provide one means for holding part of our land in the form of contingency reserves. Rights subject to easements could readily be leased during periods of increased demand, and land use would become restricted again upon expiration of leases.

The assignability of some types of easements in gross is questionable in some states, but this should not be allowed to confuse the thinking of policy makers. The question concerning the status of the easement in gross in the U.S. is concerned with the assignability of the benefit. Since the government agency might want to assign the benefit for a period by lease, this problem is an important one. Extensive research into this problem has revealed that, wherein the holder of the benefit is a public entity or a quasi public entity such as a public utility corporation, or wherein the value of the benefit

is considerable, courts consistently uphold assignability of the benefit if that is the intent of the original parties to the agreement.

Neither Constitutional law nor common law constitute obstacles to economic development in the United States. On the contrary, basic concepts of law in the United States constitute a framework for economic development which might well be the envy of other nations. Proficiency in the use of these concepts and the will to initiate and implement effective programs are the limiting factors.

Out of the study several suggestions for additional research have arisen. Some voids could probably be filled merely by improving communication between economists and workers in disciplines engaged in technological discovery and development, between economists and political scientists and between economists and legal specialists.

Structural changes in institutions usually follow informal working arrangements arising out of necessity or expediency. Agricultural economists presently work informally in many types of relationships with members of a number of disciplines and professions in designing and carrying out research. Economists have encouraged agronomists and animal nutrition specialists, for example, to design experiments in a manner to facilitate the use of production data in economic models. These relationships are gradually being formalized on a small scale. Some of these relationships might profitably be expanded in scope

and formalized on a greater scale to insure that agricultural scientists will generate data suitable for economic planning and analysis, but also to insure that economists will have a voice in the selection of research projects in areas of technological development and adaptation related to agricultural and economic development. In this manner public policy might become a greater factor in the selection of development and adaptation studies.

There is a need in the United States for a reemphasis of technologies which increase net income to farm operators without increasing output significantly. These technologies would be of special interest to farmers with very limited alternative employment opportunities. Work has been done in this area since the establishment of experiment stations, but the lack of output restraint on farm firms, from unrestricted acres, has resulted in deemphasis of this type of research.

Planning models used in underdeveloped countries should include a careful analysis of the impact of adaptation of technologies taken out of mature economies upon existing agricultural resources. It might be possible in some underdeveloped countries for governments to control the rate of release of labor from agriculture, for example, by carefully selecting technologies to be introduced in the various stages of economic development. Additional research in this area might prove profitable.

As vitamin and amino acid technologies develop, it might

prove profitable for economic planners to maintain continuous models for checking the economic feasibility of supplementing available foods in certain countries with these nutritional components. The vigor and character of some groups would be significantly improved by nutritionally complete diets made possible only by supplementing local foods with relatively cheap synthesized components.

Research is needed to determine the kinds of vocational training which would be feasible in town and country areas. It might be concluded that pre-technical training of an academic nature, similar to pre-college training, would be the most feasible function of town and country educational systems. Such schools can scarcely afford to maintain multimillion dollar training equipment which would soon become obsolete. Training in some service trades might prove to be a feasible function of town and country educational institutions. This area urgently needs investigation. Educators, economists and representatives of industries should design and carry out the research cooperatively.

The last word has not been spoken in regards to feasible agricultural programs contributing to profitable individual adjustments in employment, shifts in land use, and economic development in general. There is a wealth of legal concepts available for developing and implementing development plans. Research needs to be carried out to devise means of reducing the impact of needed resource use shifts upon individuals in

rural communities. The transitional circumstances provide an opportunity for upgrading a significant part of the labor force. Patient waiting while the agricultural labor force leaves agriculture will not prevent this labor from becoming employed in one declining industry after another. Research into possibilities for integrating agricultural programs with the growing number of retraining programs might prove profitable. Compensation for program depreciation of property values might take the form of educational opportunity, for example, in certain instances. Perhaps methods could be devised for causing payments to farm operators to contribute to resource use adjustment rather than merely to subsistence for farm families for a time.

Economists should conduct research jointly with agricultural scientists and food technologists when making projections of food productivity potential far into the future. Even if agricultural enterprise were conducted by only one million farmers, this would still constitute an industry of major importance which would continue to need assistance from experiment stations in developing technologies enabling them to cope with an increasing influx of synthesized nutritional components into the economy.

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